RECLAMATION
Managing Water in the West

Guidelines for Research and Authorship

Volume 13 *Revised and Expanded*

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region and
Denver Technical Service Center

February 2009

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The Tracy Fish Facility Improvement Program is an applied interdisciplinary research program managed by the U.S. Department of the Interior, Bureau of Reclamation to improve fish salvage at the Tracy Fish Collection Facility, Tracy, California, USA. Research results from this program are published in peer-reviewed technical reports distributed as volumes in the Tracy Series. This publication is a revision and expansion of the previously published Tracy Series Volume 13 report, Guidelines for Authors of Tracy Series Reports, and this update provides more specific guidance regarding research proposal layout, manuscript style, formatting, standards, and procedures for publishing peer-reviewed technical reports in this program.

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Guidelines for Research and Authorship

Volume 13 *Expanded and Revised*

by

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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Tracy Fish Facility Improvement Program

Ron Silva, Manager

Tracy Series Editor

Donald E. Portz, Ph.D.
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Cover

Fish photography by René Reyes, Tracy Fish Collection Facility, Tracy, California.
Design by Doug Craft.

Disclaimer

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EXECUTIVE SUMMARY

The Tracy Fish Facility Improvement Program (TFFIP) is an applied interdisciplinary research program managed by the U.S. Department of the Interior, Bureau of Reclamation, to improve fish salvage at the Tracy Fish Collection Facility near Tracy, California, USA. Research results from this program are published in peer-reviewed technical reports distributed as volumes in the Tracy Series. This publication is a revision and expansion of the previously published Tracy Series Volume 13 report, *Guidelines for Authors of Tracy Series Reports*, and provides guidance regarding research proposal layout, manuscript style, formatting, standards, and procedures for publishing peer-reviewed technical reports in this program. The purpose of this report is to help assure the scientific quality of all Tracy Series reports and Technical Notes.

This report includes an overview of the roles and assignments for authors, editors, and others involved in the production of Tracy Series reports, an outline and flowchart for the publication process, and helpful information for authors regarding style conventions and preparation of figures and tables.

INTRODUCTION

The Tracy Fish Collection Facility (TFCF), Tracy, California, is a fish salvage facility located on the intake channel of the C.W. “Bill” Jones Pumping Plant (BJPP–formerly the Tracy Pumping Plant) and the Delta-Mendota Canal, located in the Central Valley. These facilities are part of the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) Central Valley Project, Delta Unit, that were constructed during the 1950s. Delta Unit facilities are located in the southern regions of the Sacramento-San Joaquin River Delta (the Delta or south Delta; Figure 1). The TFCF and the BJPP are located adjacent to Old River, a tributary of the San Joaquin River, approximately 8 km from the town of Tracy, California.

During the late 1980s, Reclamation began implementing studies of operational processes at the TFCF to improve understanding of the present day fish salvage issues. These research activities were intended to improve the TFCF by identifying operational changes for the existing systems or recommending facility upgrades or replacement (Liston *et al*. 2000). Collectively called the Tracy Fish Facility Improvement Program (TFFIP), this group of Reclamation research activities was deemed necessary and formally authorized by the Central Valley Project Improvement Act (CVPIA) of 1992, Title 34 of Public Law 102-575. An especially significant requirement of the CVPIA is Section 3406(b)(4), stating that Reclamation should “develop and implement a program to mitigate for fishery impacts associated with operations of the Tracy Pumping Plant. Such a program shall include, but is not limited to, improvement or replacement of the fish screens and fish recovery facilities and practices associated with the Tracy Pumping Plant.” TFFIP research activities are coordinated through the Interagency Ecological Program, the Bay-Delta Program (formerly known as CALFED), and the Tracy Technical Advisory Team (TTAT). Guidance and direction of the program are provided through Endangered Species Act (ESA) Biological Opinion and CVPIA and CALFED Records of Decision documents prepared by the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and CALFED staff.

Information gathered during the early TFFIP studies was initially distributed via internal technical memorandums made available to Reclamation Mid-Pacific (MP) Region staff for decisions on funding levels and priorities. Within a short time, interagency staff from the California Department of Fish and Game, California Department of Water Resources, USFWS, NMFS, and local California water authorities began receiving this information. As TFFIP research activities and reports expanded, the need for defining quality assurance procedures for technical publications and scientifically sound analysis and reporting was recognized, and the TFFIP developed the Tracy Technical Report Series (Tracy Series).

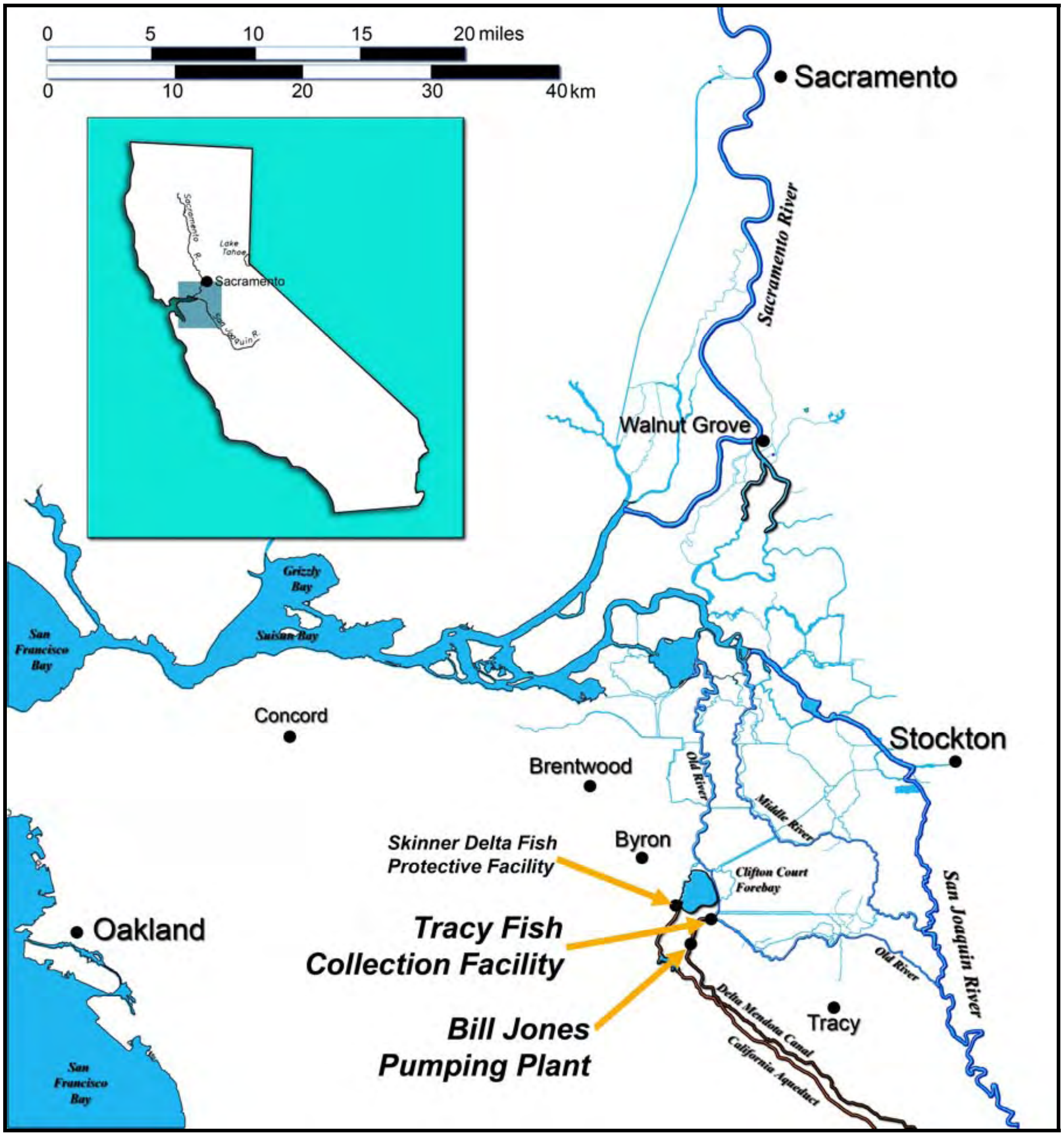

Figure 1.—Map showing the location of the Tracy Fish Collection Facility in the south Delta region of the Central Valley of California.

The accountability required for publicly funded research mandates standards and requirements for technical reports meet the criteria of good scientific practice and peer review. While earlier TFFIP reports received informal peer review and revisions, publication of Tracy Series reports since 2002 has followed more formal procedures outlined in Tracy Series Volume 13, *Guidelines for Authors of Tracy Series Technical Reports* (Craft and Liston 2003). Since then, the TFFIP has published 21 reports and 4 technical bulletins under the Volume 13 procedures as of January 2009.

The Tracy Series guidelines provide a quality assurance function to guide researchers in completing data analysis and interpretation for dissemination to the scientific community, and allow for extensive inclusion of data into a research product that would not be possible in an abbreviated journal article. While a Tracy Series report of completed TFFIP-funded research is a program requirement, authors are encouraged to submit revised versions of their Tracy reports to scientific journals such as Transactions of the American Fisheries Society (AFS), North American Journal of Fisheries Management, and other appropriate peer-reviewed publications.

This revision of Tracy Series Volume 13 addresses problems observed by editors and past authors, and provides expanded procedures and guidelines for meeting fundamental scientific standards. We also define standards for a new vehicle for rapid internet reporting of significant findings called the Tracy Technical Bulletin. This revision also provides supplemental information and forms to aid authors, reviewers, editors, and program managers.

METHODOLOGY

Review, revision, and publication of Tracy Series reports follows the procedures and standards detailed in this report and in the Appendix 1 process flowchart.

Who is the Audience?

Authors of Tracy Series manuscripts must consider the audience for these reports is not restricted to other experts in their particular discipline. At the least, the audience may include engineers, biologists, chemists, geographers, and other environmental scientists, all with specializations within their disciplines. Authors can also assume managers and the general public with no engineering or scientific background may read their reports. It is therefore important for authors to avoid assuming expert knowledge in their reader, and to always keep the audience in mind when writing and revising.

Readers who do not work for Reclamation or the other federal and state agencies operating in the Central Valley will likely have limited knowledge of the facilities, their purpose, or names used to describe facility components (*e.g.*, primary bypass, trashrack, *etc*.). Additionally, important technical terms (such as bypass ratio, velocity profile, or salvage efficiency) should be explicitly described to improve clarity. Therefore, the INTRODUCTION should provide appropriate background and explanation to enable the unfamiliar reader to make sense of these details. Authors may cut and paste the INTRODUCTION from this report (with appropriate citations) and modify to fit the needs of their manuscript. Maps, photographs, and diagrams of the facility are also elements that should be included in the INTRODUCTION, and electronic versions of these images are available on the Tracy website (www.usbr.gov/pmts/tech_services/tracy_research/).

While authors should always make special efforts to be explicit in descriptions and to clearly identify conclusions associated with particular results, it is doubly important to be direct and clear in the ABSTRACT and EXECUTIVE SUMMARY. These sections are often the only ones that will be read by non-specialists, but they will also be browsed by other scientists who are doing literature searches.

Definitions

The following terms are used in this report:

Proposal — A prepared research request clearly stating objective(s), a logical and well-written hypothesis, detailed experimental and statistical designs, indication of expected outcomes based upon background reading and sound biological judgment, projected deliverables, and an estimated budget. The research proposal should contain a clear and concise explanation of the experiment including a development of the research idea with literature citations. The METHODOLOGY should include a detailed step-by-step process to be carried out while performing the experiment (to the best of your ability), and specify kinds and quantities of materials (example research proposal format in Appendix 2).

First Draft — A properly formatted manuscript package submitted to the Tracy Series Editor (TSE) and ready for peer review. The Tracy Series volume number is assigned by the TSE on receipt of a properly formatted First Draft package. The First Draft deliverables package consists of a cover sheet and checklist (Appendix 3), a paginated manuscript (title sheet through references), with figures, tables, and appendices attached separately (example First Draft format in Appendix 4).

Peer Review — A detailed technical evaluation of First Draft manuscripts by scientists and engineers with significant experience in the report subject. Reviewers provide suggestions for improvement and an explicit recommendation on acceptance of the manuscript. Each Tracy Series report must be reviewed by two peer reviewers, and authors must make all revisions suggested by peer reviewers or formally respond to peer reviewer comments in writing to the TSE.

Ad Hoc — (Latin for "this purpose") A temporary committee that is formed for a unique and specific purpose or task, and disbanded when done. Also, a temporary role assigned to an individual or group to address review or manuscript quality issues. During the Tracy Series publication process, the TSE may assign the Science Editor (SE), based on experience and qualification, an *ad hoc* role. *Ad hoc* review or technical advisory teams may be requested by the authors or the SE, and may be convened by the TSE during any stage of the manuscript process, including the initial manuscript preparation.

Final Draft — The draft manuscript formatted in Tracy Series style and compliant with Reclamation Visual Identity requirements. The Final Draft is prepared and formatted only after editorial review and suggestions, peer review, and author revisions. Tables and figures are integrated into the body of the Final Draft manuscript. The Final Draft is distributed for comments to the TTAT, technical collaborators, and shareholders. Comments and corrections received are made available for authors' revisions before final publication. Changes and corrections at this stage of the publication process should be minor, and suggestions regarding major revisions or changes in the scope of work reported are inappropriate.

Galley Proof — The final revised and formatted manuscript ready for proofreading and quality inspection before publication and distribution. Authors should check this version carefully, indicate corrections, and respond with changes within 7 days of receipt. Adobe® Acrobat PDF files may be used at this stage for final proofreading. Major revisions will not be accepted at the galley proof stage. Serious problems with the manuscript will constitute a return to draft status.

Technical Bulletin — A rapid web-based reporting of critical or important research results or information in an Adobe® Acrobat PDF file. Technical bulletins are published on the TFFIP website (http://www.usbr.gov/pmts/tech_services/tracy_research/tracyreports/index.html) after the TSE completes copy editing and formatting, and the TFFIP Manager (TM) grants approval.

Publication Procedure Outline

The following outline may be seen in greater detail in the Appendix 1 publication process flowchart, and will be discussed more fully in later sections.

1. Generate research idea to investigate and submit proposal to TFFIP before beginning of fiscal year. Methodological and statistical consultations are recommended.

2. Science Editor (SE) and all participating researchers read and comment about the draft research packet, and appropriate revisions made before proposals are provided for further review to the Tracy Technical Advisory Team (TTAT).

3. After further revisions from TTAT members' suggestions, a final proposal will be added to other researchers' proposals and assembled into an Applied Research Study Plan for submission to the TM.

4. The TM prioritizes research projects to be accomplished under the allocated annual budget and identifies work that will be accomplished during the fiscal year.

5. Upon receiving proposal approval confirmation, relevant permits must be obtained, and standard operating procedures (SOP) and job hazard analyses (JHA) must be written for each research project. Copies of these documents must be submitted to the TFFIP Research Coordinator (RC) for distribution and filing at the TFCF. Consultation with RC and SE is recommended.

6. Principal investigator coordinates and conducts TFFIP-associated research. The TM, RC, and SE must be informed of major study design changes, and notifying these people after the work is completed is unacceptable.

7. Researchers tabulate and analyze data using appropriate statistics, and prepare relevant tables, figures, and graphs (see Tables and Figures section).

8. Authors write First Draft manuscript, include tables and figures, and proofread for spelling, grammar, context, and compliance with Tracy Series style requirements. Authors should consult with TSE at this stage regarding Tracy Series standards and any need for technical assistance to complete the manuscript.

9. Authors prepare a First Draft deliverables package that includes two printed copies and electronic versions of the manuscript components with an attached cover sheet (Appendix 4) ready for TSE review and approval. Upon delivery of the manuscript package, the TSE assigns a Tracy Series volume number and consults with the TM and the RC to assign the SE for the report.

10. The SE reviews the First Draft for readability and conformance to scientific standards. If rejected, the SE may recommend copy editing and re-writing to improve grammar, coherence, and content, or convening *ad hoc* technical teams to assist the authors with data analysis or presentation deficiencies. After revisions by the authors, the SE must approve and sign the cover sheet/checklist before the First Draft can be peer reviewed.

11. First author recommends qualified peer reviewers to TSE upon manuscript approval by SE. TSE coordinates with two peer reviewers, and mails electronic and paper copies of First Draft with peer reviewer cover sheets (Appendix 3) to peer reviewers.

12. TSE receives peer reviewer comments and marked-up manuscripts, and provides them to the first author for appropriate changes or rebuttal. Author makes appropriate changes to the manuscript, writes rebuttals for each peer comment contended, and returns them to the TSE with revised manuscript in an electronic format.

13. The TSE serves as the referee for peer review revisions, and may consult with the SE and RC during the revision and referee process. The TSE maintains all copies of peer reviewer comments, marked-up drafts, and electronic versions of all revised manuscript elements.

14. Authors make all revisions of manuscript, tables, figures, and appendices, and forward deliverables package to the TSE which now becomes the "Final Draft." The revised Final Draft package delivered to the TSE is identical in format to the First Draft (Appendix 4).

15. TSE arranges for Final Draft design and layout by the Document Preparation Specialist (DPS) and distribution of the proofread Final Draft to TFFIP collaborators, TTAT, and other shareholders for final comments. During this 4-week final review period, the RC and TM should also review the Final Draft and provide minor suggestions, if necessary. Comments are not accepted after the 4-week final review period deadline has passed. After receiving comments, the first author and the TSE discuss revisions.

16. TSE arranges for printing of the Galley Proof as an Acrobat® PDF file. The Galley Proof is proofread by the DPS, all authors, and the TSE.

17. Final version is approved by the TSE, and the report is published and distributed.

Roles and Responsibilities

The following describes the roles and responsibilities associated with publishing Tracy Series volumes. These titles are used in the flowchart (Appendix 1) that diagrams the overall publication process for Tracy Series reports.

TFFIP Manager — The TM is the overall program leader and is responsible for planning, approving, and funding research activities, along with managerial quality assurance (QA) for technical research products. TM responsibilities for TFFIP and the Tracy Series include:

- Establishing an annual research budget that sets research goals and objectives.
- Prioritizing and approving funding of individual research projects.
- Identifying program priorities for Tracy Series reports and other research deliverables to the RC and the TSE.
- Approving research results that warrant publication and dissemination through the Tracy Series, Technical Notes, posters, and oral presentations.
- Reviewing all research proposals and Final Draft Tracy Series manuscripts.
- Resolving issues and conflicts surrounding Tracy Series reports in coordination with the RC and the TSE.
- Reviewing and updating of Tracy Series mailing list and database periodically.
- Communicating with Reclamation management at the Tracy Area and South Central California Area Offices on how research results should direct maintenance and improvement actions.

TFFIP Research Coordinator — The RC serves a QA function for Tracy Series reports and helps the TFFIP Manager define the priorities for Tracy Series reports and schedules. RC responsibilities for TFFIP and the Tracy Series include:

- Identifying research projects that meet the goals of the TFFIP.

- Assisting in the design, conduct, and coordination of TFFIP studies.
- Securing scientific collectors' permits and other research permits associated with performing TFFIP research.
- Identifying research that warrants publication in the Tracy Series and advising TM on priorities, funding, and schedules for Tracy Series reports.
- Potentially serving as *ad hoc* SE depending on the subject of the report.
- Providing oversight of the publication process and suggestions to TSE and TM.
- Presenting TFFIP findings to Reclamation management, TTAT, technical collaborators, shareholders, regulatory agencies, and the community upon TM approval.

Tracy Series Editor — The TSE is responsible for managing the entire Tracy Series publication process, including workflow, reviews, revisions, scheduling, documentation, and advising authors regarding accepted procedures for publishing Tracy Series reports. The TSE performs the following duties:

- Advises and consults with TM and RC regarding budget, priority, and scheduling.
- Appoints the *ad hoc* SE for a submitted manuscript who will review, and then approve or reject the submitted First Draft before peer review.
- Assists authors directly or arranges *ad hoc* assistance for tables, figures, statistics, and technical writing.
- Makes arrangements for peer review of First Draft manuscripts.
- Serves in conjunction with SE as referee for peer reviewer comments and suggested revisions of First Draft manuscripts. Consults with authors on revisions.
- Coordinates formatting and printing of Final Draft. Distributes peer-reviewed and printed Final Drafts to TTAT, technical collaborators, and shareholders on the Tracy Series mailing list for additional comments.
- Arranges for final copy editing, proofreading, and style formatting. Reviews and inspects pre-publication galley proofs. Distributes published Tracy Series reports and journal article reprints using the current Tracy Series publication mailing list.
- Maintains the Tracy Series mailing lists, and archival filing and storage of reports and comments.
- Coordinates maintenance of the TFFIP website, which contains proposals and final reports.

Science Editor — The SE may be a formal or *ad hoc* position, defined for specific disciplines or reports. The TSE assigns the SE role when the First Draft manuscript package is initially submitted. Depending on the perceived need and technical disciplines involved, the RC or TSE may serve in the SE capacity. For example, a hydraulic engineer may be assigned as SE on a hydraulics engineering manuscript, or a limnologist on a water quality manuscript. The SE is tasked to assess whether a submitted First Draft manuscript is technically sound and meets Tracy Series standards and good scientific practice. The SE has the authority to recommend rejection of substandard manuscripts, and no manuscript may be sent out for peer review until approval by the SE. Some specific roles for the SE include:

- Assists in identifying and establishing research projects that meet the goals and objectives of the TFFIP.
- Inspects and reviews all proposals and First Draft manuscripts prior to peer review, emphasizing adherence to scientific method, clear formulation and testing of hypotheses, and proper experimental methodologies and use of statistics.
- In consultation with the TSE, approves or rejects manuscripts.
- Suggests formation of *ad hoc* technical assistance committees, graphics specialist assistance, or technical editing to improve manuscript deficiencies.
- Assists with arrangements for peer review of First Draft manuscripts, and consults with the TSE on referee issues.
- Reviews Final Drafts during comment period and suggests minor corrections, if necessary.

Authors — Authors are ultimately responsible for the technical quality of their work and adherence to principles of good scientific practice. Because of the complexity and specialization associated with TFFIP research, Tracy Series editors and managers must assume the authors possess expert knowledge for their study and are experienced investigators.

Co-authors must play significant roles in the planning and execution of research studies, the analysis of data and development of conclusions, and in the writing and revision of the Tracy Series manuscript. The first author should not include secondary authors unless they are significant participants. The order of author names is assumed to represent the relative level of contribution. Avoid gratuitous, irresponsible, and/or unnecessary authorships (Fabrizio 2000). Authors should use the ACKNOWLEDGMENTS section in the manuscript to thank other participants who helped with funding, coordination, technical consultation, or field work.

The first author is the primary contact with the TSE and SE during the review and publication process. The first author is also responsible for gathering and incorporating comments and changes from co-authors. All authors should discuss changes and revisions at each stage of the process: manuscript writing, editorial and peer review, and proofing of Final Drafts and publications. Tracy Series authors are also responsible for:

- Following Tracy Series standards for style and scientific quality.

- Clearly establishing goals and objectives of work and importance to TFCF operations.
- Writing or coordinating a clear, concise, grammatically correct First Draft.
- Producing and providing informative and relevant diagrams, graphs, tables, and photographs.
- Assuring authenticity and accuracy of statements and scientific findings.
- Providing all methodological information needed to comprehend work and allow other researchers to repeat the work in the future.
- Integrating results in a relevant manner to already published findings.
- Avoiding speculation or going beyond the limits of results.
- Avoiding redundancy, verboseness, jargon, and slang.
- Affirming all authors have contributed substantially to the manuscript.
- Recommending qualified peer reviewers to review the First Draft.
- Making revisions to First Draft in consultation with the TSE and SE.
- Making revisions to Final Draft based on collaborator comments.
- Proofreading galley proof before distribution.
- Advising TSE of any additional names and addresses to be included in the Tracy Series mailing list.

Peer Reviewers — After the authors, peer reviewers play the central role to help improve the accuracy, quality, and rigor of work, and to help assure the manuscript adheres to principles of good scientific practice.

Peer reviewers should perform thorough and detailed reviews intended to improve the scientific quality of Tracy Series publications. Therefore, authors should strive for a professional attitude regarding reviewer (and editor) comments and consider that everyone involved in the Tracy Series process desires to publish the best possible scientific work. High quality, well-written reports reflect positively on both the authors and the TFFIP. Authors should not take peer reviewer comments personally, and peer reviewers should also take care to make their comments professional, impersonal, and to offer suggestions and/or additional references to correct problems and improve the manuscript. Personal criticism is inappropriate.

When choosing peer reviewers for a Tracy Series volume, authors need to recommend people with significant experience in the required technical areas. This is especially true because of the interdisciplinary nature of fisheries, bioengineering, and environmental studies reported in the Tracy Series. For example, both biology and hydraulic engineering expertise should be sought for peer review of a report describing testing of fish with a new screen design. The application of statistics, mathematics, and numerical models—and conclusions drawn from use of these methods—should be reviewed by someone knowledgeable in their proper use and interpretation. In general, a minimum of two peer reviewers should be selected, but more may be appropriate depending on the breadth of technical disciplines presented.

Because TFFIP research is highly specialized, it is critical authors choose peer reviewers who are experts in the manuscript subjects, and who will take sufficient time (1–2 staff days) to perform a thorough review with detailed comments. Technical and scientific reports are very complex documents with significant amounts of detail and information to assess. Therefore, a peer review with few comments cannot help the authors improve their manuscript.

The peer reviewers' cover sheet, attached to all First Draft manuscripts sent to the reviewers, may be found in Appendix 3. Recommended guidelines for Tracy Series peer reviewers when reviewing manuscripts are:

- Rigorously assessing a given manuscript within the time limits specified.
- Commenting on the strengths and weaknesses of the study, and suggesting ways to improve the manuscript.
- Commenting on the manuscripts accuracy, clarity, importance, and usefulness to TFFIP and the scientific community.
- Treating the author and manuscript in a professional, confidential manner.
- Declining the invitation to peer review if the deadline cannot be met.
- Declining peer review duties if not truly knowledgeable about research subject.
- Declaring their choice of anonymity to the TSE.
- Requesting to be recused if there are conflicts of interest or bias against researchers/research.
- Not insisting that their published work be referenced in an unreasonable manner.

Document Preparation Specialist — The DPS assists the TSE in designing and laying out drafts of the Tracy Series report. The DPS makes editorial and formatting changes to the Final Draft after being provided with revised electronic files and manuscript mark-up copies. The DPS is also tasked with the following:

- Ensuring compliance with Reclamation Visual Identity requirements.
- Following Tracy Series layout, formatting, and style requirements.
- Consulting with TSE to resolve technical layout issues and problems regarding style conformance.
- Printing, checking, and correcting Final Drafts and proofs for layout, widow/orphan, headers, footers, and pagination problems.
- In coordination with the TSE, preparing Tracy Series Final Report based on comments received on Final Draft markups.

- Creating an Adobe Acrobat® PDF file of the Final Draft, printing a test copy for inspection by the DPS and TSE, and fixing any problems.
- Emailing the Final Draft PDF file to first authors and the TSE.
- Coordinating printing and mailing of the TSE-approved Final Report using the current Tracy Series mailing list (if function not performed by TSE).

Duplicate Publication

Authors are encouraged to publish their findings initially in the Tracy Series and then subsequently in appropriate scientific journals and technical meeting proceedings. Tracy Series authors must contact journal editors to determine eligibility of their manuscript for duplicate publication. Depending on the journal, data and conclusions previously made available through governmental publications (*i.e*., Tracy Series) are acceptable for duplicate publication even if they are distributed through abstracted series (Kendal 1981).

Tracy Series Report Standards

Appropriate Style and Standards — Authors should refer to usage and style in the *Government Printing Office Style Manual* (U.S. Government Printing Office 2000) as the primary standard, and *The Chicago Manual of Style* (University of Chicago 1993) for grammar and style issues not covered in this volume. *The Elements of Style* (Strunk and White 1999) may also be a helpful resource for proper grammar and punctuation. Beyond these standards, written style for Tracy Series reports should emphasize clear technical writing with minimal passive voice sentence construction, concise paragraphs with only one subject, and proper grammar and spelling. Poorly written manuscripts will be returned to authors for revisions before acceptance as a Tracy Series First Draft.

Biological terminology and usage should follow AFS recommendations (Hunter 1990). Taxonomic and common names of North American fish species should follow the AFS's most recent edition of *Common and Scientific Names of Fishes from the United States, Canada, and Mexico* (Nelson *et al*. 2004). Names of aquatic invertebrates should follow *Common and Scientific Names of Aquatic Invertebrates from the United States and Canada* (Williams *et al*. 1989, Turgeon *et al*. 1998, Cairns *et al*. 2002, McLaughlin *et al*. 2005). Current taxonomic and common names for aquatic and riparian vegetation can be found at the *Integrative Taxonomic Information System* (ITIS 2008). Common names may be used in the Tracy Series, however they must be accompanied by their scientific name when first mentioned in the ABSTRACT, EXECUTIVE SUMMARY, and body text of the report. Chemical and water quality terms should follow American Chemical Society (ACS) guidelines (Dodd 1986). Hydraulic and civil engineering terminology should follow American Society of Civil Engineers guidelines (ASCE 2007).

All tables and figures should contain proper application of significant figures (ASTM 2003) and authors should consider guidelines suggested by Tufte (1997, 2001) for clear and revealing tables, graphs, and charts that "tell the story." Statistical nomenclature should conform to American Statistical Association (2007) standards.

Specific Tracy Series Style Requirements — The following sections provide unit and abbreviation conventions for use in U.S. Government reports and Tracy Series publications:

Reference to Figures and Tables

- Capitalize the words Figure and Table in all in-text references that include numbers (*e.g.*, "see Figure 2").

Unit Rules

- Use SI (Système Internationale d'Unités) metric units except where English units are widely used (Reclamation 1978). In these cases, English units should follow the SI units in parentheses. See Appendix 5 – Useful Unit Conversions.
- Spell out measurement units that do not appear below under Common Abbreviations on first use and include the standard abbreviation in parentheses, and *always* use the abbreviations thereafter.
- Use "/" for "per" as the style for units, rather than negative exponents.

  2.5 m/s rather than 2.5 ms^{-1}
- Use 24-h time references rather than AM and PM.

  1800, or 1800 h, rather than 6:00 PM
- Use hours, minutes, and seconds, and north (N), south (S), east (E), and west (W) for latitude and longitude:

  120°15'25" W, 36°26'06" N
- Use a hyphen between number and unit if the number and unit are used as an adjective:

  a 4.6-L bucket, a 12-ft beam, a 25-mL pipet

Miscellaneous Tracy Series Usage

- Use *italics* for emphasis; do not use **boldface** or underlining.
- Use "and" rather than the ampersand (&).
- Use "at" rather than the "at sign" (@).
- Data are plural, *datum* is the singular form.
- Put commas and punctuation *inside* quotation marks, *outside* parentheses.

  Called "Mr. Data," the consultant was a renowned expert.

  Results are corroborated by Jones (1997), who studied species in Alaska.
- Use "s" when referring to spans of decades or centuries.

  The 1980s, the 1990s.

- Consistently use two spaces after punctuation between sentences.
- The hyphen (-) is used both to join words and to separate syllables.
- The en dash (–) is used in ranges, such as 3–5 years, read as "3 to 5 years". There are no spaces before or after the en dash. The en dash can also be used to contrast values, or illustrate a relationship between two things. On Microsoft Windows®, an en dash may be entered as Alt+0150, where the digits are typed on the numeric keypad while holding the Alt key down.
- The em dash (—) is used to distinguish a parenthetical thought—similar to this one—in a sentence. Often used with an insertion to give clarity to a sentence. There are no spaces before or after the em dash. On Microsoft Windows®, an em dash may be entered as Alt+0151, where the digits are typed on the numeric keypad while holding the Alt key down.
- Capitalize federal and state when used as part of an official agency name or when these terms represent an official name. Use lowercase letters when they are referring to general terms.
- When *2* or more numbers appear in a sentence and *1* of them is *10* or larger, numerals are used for each number.

  Each of 15 major commodities (9 metal and 6 nonmetal) was in supply.
  but Each of nine major commodities (five metal and four nonmetal) was in supply.
- A unit of *measurement*, *time*, or *money* is expressed in numerals and does not affect the use of numerals for other numerical expressions within a sentence.

  This usually requires from two to five washes and a total time of 2 to 4 hours.
- Numbers of less than *100* preceding a compound modifier containing a numeral are spelled out.

  twelve 6-inch guns *but* 120 8-inch boards

Species Names

- Include the genus and species name (*italized*) for any organism on first reference in parentheses after the common name. Abbreviate genus name if used elsewhere for other species of the same genera.

  splittail (*Pogonichthys macrolepidotus*)

  Clear Lake splittail (*P. ciscoides*)

  Use the common name to refer to that species thereafter.
- Capitalize genus, but not species.
- Do not capitalize common names in text unless a proper noun is part of the name.

  Sacramento blackfish

- The first word of common names should be capitalized in tables.
- Genus, species, and family names for fish salvaged at the TFCF are summarized in Appendix 6.

Abbreviations

- Spell out organizations and complex terms followed by the abbreviation in parentheses, and use the abbreviation thereafter.
- Treat the ABSTRACT, EXECUTIVE SUMMARY, and the rest of the manuscript as stand-alone elements with respect to the first use rules for measurement units and abbreviations. Even if you define a unit or abbreviation in the ABSTRACT, you must re-define the unit or abbreviation in the EXECUTIVE SUMMARY and *again* in the manuscript (starting with the INTRODUCTION).
- Abbreviations used in Figures and Tables must be defined in caption.

Latin Term Abbreviations — Correctly use the following abbreviations for Latin terms without explanation:

ad lib. (*ad libitum*) means "according to what pleases" or "as you wish."
“While young hatchery fish are growing, they will need a higher protein level and can generally be allowed food *ad lib*.”

ca. (*circa*) means “around, about, or approximately.”
“Striped bass were originally introduced by railcar to California (*ca*. 1879).

cf. (*confer*) means “compare” or “consult.”
"These results were similar to those obtained using different techniques (*cf*., Smith 1999, Doe 1992)."

e.g. (*exempli gratia*) means “for example.” Often confused with *i.e*.
“Intense exercise for even short-time periods (*e.g*., 5–10 min) can result in metabolic or mixed acidosis.”

et al. (*et alii*) means “and others.” Used to stand for a list of names.

etc. (*et cetera*) means “and the rest” or “and so on.”

i.e. (*id est*) means “that is” or “in other words.” Often confused with *e.g*.
“Thyroid hormones, which promote protein synthesis (*i.e*., anabolic processes), are at reduced levels in the plasma of fishes held at high densities (*i.e*., thyroxin).”

sic (*sicut*) meaning "thus", "so", or "just as that." It is placed within square brackets and italicized–[*sic*]–to indicate that an incorrect or unusual spelling, phrase, and/or other preceding quoted material has been reproduced verbatim from the quoted original and is not an error:

“Derrick noted that the colorful coy fish were phat [*sic*]”

Common Abbreviations — The following symbols and abbreviations are used in the Tracy Series without definition. Abbreviations and symbols not listed here must be defined at first mention in the text.

- ***General***

east	E
north	N
south	S
west	W
male	♂
female	♀
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
Copyright	©
Registered trademark	®
Trademark	™
days (in tables and figures)	Sun., Mon., Tue., Wed., Thurs., Fri., Sat.
months (in tables, figures)	Jan., Feb. Mar., Apr., Aug., Sept., Oct., Nov., Dec. (May, June, July spelled out)
species (singular)	sp.
species (plural)	spp.
versus	vs.
fork length	FL
standard length	SL
total length	TL

- ***Numerical***

kilo (10^3)	k
mega (10^6)	M
giga (10^9)	G
milli (10^{-3})	m
micro (10^{-6})	µ
nano (10^{-9})	n
pico (10^{-12})	p

- ***Time***

second	s
minute	min

day	d
hour	h

- ***Temperature***

degrees Celsius	ºC
degrees Fahrenheit	ºF
Kelvin	K

- ***Weights and Measures***

microgram	µg
gram	g
kilogram	kg
micron	µm
millimeter	mm
centimeter	cm
meter	m
kilometer	km
deciliter	dL
liter	L
hectare	ha
ounce	oz
pound	lb
fluid ounce	fl. oz.
gallon	gal
inches	in
foot	ft
mile	mi

- ***Mathematics and Statistics***

logartithm to the base b	logb [*e.g.*, $\log_{10}(x)$, $\log_2(x)$]
base of natural logarithm	e
natural logartithm	ln [*e.g.*, ln(x)]
degree (angular)	º
minute (angular)	‘
second (angular)	“
percent	%
common test statistics	(F, t, *etc*.)
confidence interval	CI (specify associated percentage)

correlation or regression	r
correlation coefficient	r^2
degrees of freedom	df
not significant	NS
probability	*P*
sample size (population)	N
sample size (sample)	n
standard deviation	s, SD
standard error	SE
sample variance	s^2, Var

- ***Physics and Chemistry***

alternating current	AC
ampere	A
calorie	cal
direct current	DC
electron volt	eV
equivalent	eq
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
joule	J
lethal concentration, 50%	LC_{50}
lethal dose, 50%	LD_{50}
lumen	lm
lux	lx
molar	M
mole	mol
newton	N
ohm	Ω
parts per billion	ppb
parts per million	ppm
parts per hundred	%
parts per thousand	‰
pascal	Pa
siemens	S
volt	V
watt	W

- ***Money***

dollar	$
cent	¢
euro	€

Common Standard Terms — Use the following standard organizational terms and abbreviations in Tracy Series reports, following first usage abbreviation reference:

California Department of Fish and Game – CDFG
California Department of Water Resources – CDWR
California State Water Project – SWP
C.W. “Bill” Jones Pumping Plant (formerly Tracy Pumping Plant) – BJPP
Central Valley Operations Office, Sacramento, California – CVO
Central Valley Project – CVP
Central Valley Project, Delta Division – CVPDD
Central Valley Project Improvement Act of 1992 – CVPIA
Clifton Court Forebay – CCF
Delta Cross Channel – DCC
Delta-Mendota Canal – DMC
Harvey O. Banks Pumping Plant – BPP
Interagency Ecological Program – IEP
John E. Skinner Delta Fish Protective Facility – SDFPF
Tracy Fish Collection Facility, Tracy, California – TFCF
Tracy Fish Facility Improvement Program – TFFIP
Mid-Pacific Regional Office, Sacramento, California – MP
National Marine Fisheries Service – NMFS
National Oceanic and Atmospheric Administration – NOAA
Sacramento-San Joaquin Delta – Delta or south Delta
San Luis-Delta Mendota Water Authority – SLDMWA
South-Central California Area Office, Fresno, California – SCCAO
California State Water Resources Control Board – SWRCB
U.S. Department of the Interior, Bureau of Reclamation – Reclamation
U.S. Department of the Interior, Fish and Wildlife Service – USFWS
U.S. Department of the Interior, Geological Survey – USGS

First Draft Layout and Format

Tracy Series First Drafts must be written using Microsoft® Word and have only basic document formatting. First Drafts must be double-spaced and left-justified, using

12-point Times New Roman font, and have 1.25-in margins all around with centered bottom page numbering.

The First Draft Package — A First Draft package must be delivered to the TSE that includes both printed and electronic versions of the report. Authors must submit two printed copies of the First Draft along with a CD-ROM containing all relevant electronic files (see section below). The printed First Draft should be divided into separate sections, each with a cover sheet as seen in the Appendix 4 example. The sections are the Manuscript (containing the expository text only), Tables, Figures, and Appendices. Authors must attach a completed *Authors' Check List* (Appendix 3) as a cover sheet with the First Draft package.

First Draft Manuscript — The First Draft Manuscript should include the following elements and sections:

Title Page: See this report for example title page.

Title: A clear, concise, and attractive statement that accurately reflect the papers content. Scientific names should not be included in the title.

Abstract: A brief and concise summary of the work, no more than 200 words. One to two sentences should describe the Tracy program and the purpose of the investigation. One to two sentences should describe the methodology. Include a sentence for each of the major conclusions of the report. This abstract will be posted on the Internet by the National Technical Information Service (NTIS) for online literature searches.

NTIS Key Words: Words that are used for the NTIS library and web literature searches in addition to those already present in the title. Judicious use of keywords may increase the ease with which interested parties can locate your article.

Table of Contents: See example in this report. Major sections and sub-sections in the First Draft do not require pagination reference; however, a table of contents can be created in Microsoft® Word with only minor difficulty. Tables and their captions, figures and their captions, and appendices and their titles are listed separately.

Executive Summary: An extended abstract that will be read by non-specialists that should not exceed 600 words. Include a shortened version of the INTRODUCTION, the METHODOLOGY, paragraph(s) expanding on each of the significant results, and then a shortened version of the CONCLUSIONS.

Introduction: An overview of the Tracy program, facility, and the purpose and importance of the study with clear goals and objectives. Authors should cite relevant literature for a clear development and statement of a hypothesis and reasons for use of techniques.

Methodology: A specific description of how the investigation was performed and what techniques were applied. Authors must be explicit in providing details of procedures, equipment, software, and instrumentation (manufacturer, model, description) for the reader to clearly understand or other researchers to duplicate the study. The METHODOLOGY section should also include information about the study site, source of fish, data analyses (statistical methods with relevant statistical values; *e.g.*, *P*-values), or computer models (name, references, version, assumptions, conditions). Statistical designs and models used should be appropriate for the experimental design. A table or figure for complex study plans or experimental protocols may be helpful.

***Results*:** The text describes the noteworthy findings of the study and analyses. Results should be represented as figures and tables if appropriate and indicate significance of tabular values with asterisks or lower case letters. All relevant statistical information should be included (*e.g.*, significance level, *P*-values, sample sizes, *etc*.). All tables and figures must be referred to in the text, numbered consecutively (with Arabic numerals), and placed as close as possible to the original text reference. Tables and figures should be able to stand alone without reference to text or any preceding or subsequent tables and figures. Avoid presenting data in the form of tables or figures that could easily be replaced by a sentence or two of text. The term “figure” includes all types of graphic illustrations (*e.g.*, charts, graphs, photographs, illustrations, and maps).

Discussion: Exposition synthesizing the main contributions of the study and the interpretation of the results. Discussing the results should advance the knowledge and understanding of the respective topic. The author must compare and state how their findings agree with previously published work. Be cautious not to simply restate the results and speculate beyond the reach of the data. Clearly discuss and state whether the author has accepted or failed to accept each hypothesis and if the objectives stated in the INTRODUCTION were met. If the discussion section is brief and easily understood it may be combined with the RESULTS section.

Conclusions and Recommendations: Summarize major findings, significance, scientific and policy implications, and recommendations for future studies. This section may be incorporated into the later part of the discussion, if brief.

Acknowledgments: Give credit to the programs and individuals who supported the work, and to the staff who contributed directly to the research, statistics, and manuscript development.

References: See the following section for reference style.

Appendices: (if necessary): An appendix may contain more extensive tabular data, computer model input and output, or statistical analysis printouts not included in the results, or additional discussion. Appendices must be mentioned and described in the manuscript. If more than one appendix is used, they should be consecutively numbered with pagination indicating the appendix number (A1-1, A1-2, *etc*.). Each appendix should have a cover sheet (example in Appendix 4). Similarly, appendix tables and figures should include the appendix designator (A1, A2, A3, *etc*.) in the figure and table names and captions: Table A1-1, Table A1-2, Figure A1-1, *etc*.

Tables and Figures in First Draft — Tables and figures are attached as a separate section to the First Draft package with a cover sheet (example cover sheet in Appendix 4). Figures precede tables at the end of the manuscript. The caption for each table or figure must appear at the top of the page and each page should have only one table or figure (assuming it can be fit to one page). Tables and figures should clearly present information to condense data, summarize results, and highlight trends. Raw data are never included in the body of the manuscript unless they are needed to give evidence for specific conclusions which cannot be obtained by looking at analyzed data. Raw data and preliminary analysis results may be provided in appendices. All data tables should have appropriate significant figures.

Create tables using Microsoft® Word formatting with single-line grids and 0.02-in top and bottom cell margins. Use Arial fonts only. Avoid using smaller fonts (anything smaller than 8 points will be difficult to read). Column and row headers should be boldfaced, and must include the capitalized variable name with unit of measure in parentheses.

Each table should fit a single page within 1.25-in margins with room at the top for the caption. If larger tables are needed to summarize experimental results, authors should break the tables up into smaller and logical groupings, and name them using a, b, c. . . designators, such as: Table 1a, Table 1b, and Table 1c.

File Names for First Draft Elements — The manuscript, tables, figures, and appendices should be saved as separate Microsoft® Word files and included in the CD-ROM accompanying the required printed First Draft copies. Clearly name the separate files according to section, figure number, or table number in the First Draft, for example:

Tracy Vol 13 FIRST DRAFT Manuscript.doc
Tracy Vol 13 Figure 1 area map.doc
Tracy Vol 13 Table 2 sampling locations.doc
Tracy Vol 13 Appendix 6 Table 6-1 Tracy fish species.doc

Photos and other image files used for figures should also be included separately in their native image format (see section below on accepted image file types and sizes):

Tracy Vol 13 Figure 1 area map.jpg
Tracy Vol 13 Figure 2 sampling locations.tif

While these file saving and naming requirements may seem excessive, they are critical for several reasons. First, they are an archival copy of the original graphics and tables that can be used as a backup. Second, during revisions to prepare the Final Draft, changes (such as annotation or color correction of photographs) may be more readily performed on separate and original files. Finally, separate and clearly named files make the document design phase for the Final Draft a simpler and less confusing job. Authors should consider the following guidelines when preparing figures:

Graphics File Size and Type: Some images look good on screen, but are less impressive when printed. The primary reason for poor print resolution is poor quality of the original image. A poorly exposed, focused, and composed image will look bad even if it is scanned and cleaned up properly. Poor print quality may also be caused by graphics files that are too small (not enough pixels), poorly or incorrectly scanned source images, and poor digital image correction.

TIF (tagged image file) image files are widely recognized by different programs and operating systems, support true color rendering, and do not compress image files to save space. When saving the image file in Photoshop® or Corel Draw®, the bit order should be IBM (you are usually allowed to choose between IBM or Macintosh bit order), and the color scheme should be true color RGB (red - blue - green). Do not compress the file; however, black and white photos or line art diagrams should be converted from RGB color to gray scale to reduce file size. For best image quality, import only uncompressed TIF format files directly into Microsoft® Word documents that are saved as separate figure files. JPEG formats are also acceptable.

Required Image Properties: Photographic and other complex graphics files must have a minimum pixel density, or *resolution*, of 300 dots per inch (dpi), for an image to be printed clear and sharp. So, if you wish to print the image at 3 inches by 5 inches in a report, the file needs to have a minimum of (3 x 300) + (5 x 300) = 2,400 pixels (image pixel dimensions of 900 x 1,500). Similarly, an 8- by 10-inch image would need to have a minimum 5,400-pixel file (image pixel dimensions of 2,400 x 3,000).

Scanning Existing Photographs: Scan already existing photographic prints at 300 dpi. Scanning under higher resolutions is useless, as a print has already lost clarity and sharpness. Do not print a scanned image bigger than the original.

Scanning Slides and Negatives: Film and slides contain many thousands to millions of dpi, due to the very small size of image crystals (physical versions of pixels) in the emulsion. So, film and slides are excellent image sources and archival media. Scan slides and negatives at 2,400–4,000 dpi or higher. A 35-mm film slide or negative will be 39 by 23 mm (1.54 by 0.905 inch) and will provide an image of approximately 5,800 pixels if scanned at 2,400 dpi. This file size should have enough pixels to provide a sharp, 6.5- by 10-inch reproduction on paper. Remember to blow or static brush the slides before scanning.

Scanning Line Art: Because graphs and line art will more readily show pixilation and rough edges, scan these images at 600–1,200 dpi at the same size you want them to appear in the report. If the image is black and white, do not scan in color. If color is not essential, you can reduce file size significantly.

Table and Figure Referral in First Draft — In the body of the First Draft manuscript, tables and figures should be attached *separately* from the manuscript text. No tables or figures may be included that are not specifically mentioned in the manuscript body. Within the text, refer to tables and figures in boldface immediately *following* the paragraph they are first mentioned:

Insert Here **** Table 2.—Sampling sites and variables measured at low tide.**

Insert Here **** Figure 5.—Salvage efficiency for delta smelt at the Tracy Fish Collection Facility**.

This approach provides clear cues to peer reviewers to flip to the appropriate figure or table associated with the text, and also provides layout instructions to the document designer when the peer review revisions are complete and the Final Draft is prepared for distribution and comments.

Copyright and Trademark Issues — It is easy to copy and paste internet images into a Microsoft® Word document, however these images are copyrighted and protected by law. It is illegal to use them without permission. Similarly, authors may wish to use data or tables published in manufacturers' equipment manuals. These materials are also usually copyright protected, and are indicated as such by the copyright sign, the copyright owner, and the year (*i.e.*, © Microsoft® Corp., 2005). It is the author's obligation to obtain written permission to reproduce all copyrighted materials. The written letters of permission must be submitted with the manuscript upon submission. If the material is not reproduced exactly as originally published, then it should be stated as "modified from author (date)" and must be included in the REFERENCES section. If the image or material is not protected by copyright (for example, a scanned or digital USGS or other federal government image or map), authors should acknowledge the image or data source in the caption or manuscript text using a reference, or statement such as, "Reclamation photograph by René C. Reyes."

Authors should also make proper use of the trademark applied for (™) and registered trademark (®) symbols – usually associated with company and product names. This is a common problem in the METHODOLOGY section, where such references are common. These symbols are usually applied to product names that include combined words and unique spellings that are usually associated with a unique manufacturer or product. Examples include Microsoft®, Google™, or Photoshop®. Authors can find out quickly whether a company or product name is trademarked using a simple internet search.

Final Draft Style Guidelines

The Final Draft of the Tracy Series report should follow the general guidelines stated in this volume and if not mentioned herein, then adhere to those established by *Government Printing Office Style Manual* (2007). Further details are summarized under the Reclamation Visual Identity requirements (Bureau of Reclamation 2007). The primary section headers of the report should be center-justified, capitals and small capitals, Arial font, and font size 18 points, such as:

INTRODUCTION

Major topics within each section should be left-justified, initial capitals, Arial font, font size 14 points, and separate from text, such as:

Electrofishing Methods

Because of the variety of stream depths associated with the different species of interest, both backpack and boat electrofishing techniques were used in this study.

Subtopics should be boldface type, initial capitals, Arial font, font size 12 points, within expository text, with an "em dash" shown as:

Electrical Fields and Fish — Current density is the electrical field parameter most directly related to the effects of electricity on fish.

An additional tier of subtopics may be required. If so, authors should use bold and italic 12-point type and initial capitals followed by a colon for titles that are indented by 0.25 in:

Electroshock Effects: Fish react to electroshocking in several ways, depending on the type of current and voltage applied.

Reference Style

References should emphasize peer-reviewed journal articles rather than books, symposium proceedings, government reports, internet sources, and other grey literature.

Titles of articles should be transcribed *exactly* as found in the original publications. Conventions for Tracy Series report text regarding scientific names and capitalization do not apply to reference titles. Do not abbreviate journal names.

For journal and periodical article titles, only the first letter of the first word is capitalized. For book titles and journal names, capitalize the first letter of all words (except words such as 'and', 'or', 'but', 'the', 'a', 'an', 'of', 'to', 'in', 'from', *etc*.).

Personal communication references should be *avoided* unless absolutely necessary, especially if there is another published source cited in your text. Authors should make a diligent effort to cite published sources rather than relying on personal communications. References should be cited in the manuscript using the (author year) style. Two authors may be cited as (Smith and Jones 1995), while more than two authors should use the (Smith *et al*. 1996) format. Same author, same year citations should be assigned as

(Smith 1994a) and (Smith 1994b). References to authors in a sentence can use the following format: "Smith (1995) had suggested that. . ." Arrange multiple citations chronologically (oldest first) in sentence. Institutional authors (if name is long) may be cited as acronyms in the text, but such acronyms must be cited in the REFERENCES. For example, "NAAFE *et al*. (2007)" cited in a sentence appears in the REFERENCES as NAAFE (North American Association of Fisheries Economists).

The REFERENCE section should be arranged in alphabetical order, with same author references arranged chronologically. References with single authors precede those with two authors, and both precede references with multiple authors. If personal communications must be cited, then insert their name and affiliation in parentheses into the text (D.M. Smith, Bureau of Reclamation, personal communication) and make reference in the literature cited section.

Refer to the following examples for proper reference styles of literature:

Journal and Periodical Articles — [author(s); year; title; journal; volume; issue (if necessary); pages].

Haefner, J.W., and M.D. Bowen. 2002. *Physical-based model of fish movements in fish extraction facilities*. Ecological Modeling 152:227–245.

Portz, D.E., C.M. Woodley, and J.J. Cech, Jr. 2006. *Stress-associated impacts of short-term holding on fishes*. Reviews in Fish Biology and Fisheries 16:125–170.

Books — [author(s); year; title; edition; publisher; city; state (if necessary)] Omit the number of total pages.

Steel, R.G.D., J.H. Torrie, and D.A. Dickey. 1997. *Principles and Procedures of Statistics: A Biometrical Approach*, Third edition. McGraw-Hill, New York.

Stumm, W. (editor). 1987. *Aquatic Surface Chemistry: Chemical Processes at the Particle-Water Interface*. John Wiley and Sons, Inc., New York.

Stumm, W., and J.J. Morgan. 1996. *Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters*, Third edition. John Wiley and Sons, Inc., New York.

Chapter or Section in Book — [author(s); year; title; inclusive pages; editor(s); book title; publisher; city; state (if necessary)]

Stone, A.T., and J.J. Morgan. 1987. *Reductive dissolution of metal oxides*. Pages 221–254 *in* W. Stumm, editor. Aquatic Surface Chemistry: Chemical Processes at the Particle-Water Interface. John Wiley and Sons, Inc., New York.

Wedemeyer, G.A., B.A. Barton, and D.J. McLeay. 1990. *Stress and acclimation*. Pages 451–489 *in* C.B. Schreck and P.B. Moyle, editors. Methods for Fish Biology. American Fisheries Society, Bethesda, Maryland.

Symposium Proceedings — [author(s); year; title; inclusive pages; editor(s) if available; Symposium title; publisher; city; state (if necessary)]

Helfrich, L., C. Liston, and D. Weigmann. 1999. *Trends in catfish abundance in the San Francisco-San Joaquin Delta, California, determined from salvage at the Tracy Fish Collection Facility: 1957–1996*. Pages 341–352 *in* E.R. Irvin, W.A. Hugert, C.F. Rabeni, H.T. Schramm, and T. Coon, editors. Catfish 2000: Proceedings of the International Ictalurid Symposium. American Fisheries Society, Symposium 24, Bethesda, Maryland.

Dissertation or Thesis — [author; year; title; dissertation; university; city; state (if necessary)]

Portz, D.E. 2007. *Fish-holding-associated stress in Sacramento River Chinook salmon (Oncorhynchus tshawytscha) at south Delta fish salvage operations: effects on plasma constituents, swimming performance, and predator avoidance*. Doctoral dissertation. University of California, Davis.

Baskerville-Bridges, B. 1996. *The nutritional role of bacterial aggregate for fathead minnows (Pimephales promelas)*. Master’s thesis. University of California, Davis.

Tracy Series Reports — [author(s) or agency; year; title; publication type and number; agency; city; state (if necessary)]

Craft, D., R. Housewright, L. Mao, and J. Fields. 2002. *Semi-continuous water quality measurements at the Tracy Fish Collection Facility, Tracy, California, April 2000 to March 2001*. Tracy Fish Collection Facility Studies, Volume 17, U.S. Bureau of Reclamation, Mid-Pacific Region and Denver Technical Service Center.

Governmental Reports — [author(s) or agency; year; title; publication type and number; agency; city; state (if necessary)]

Brannon, J.M., D. Gunnison, P.L. Butler, and I. Smith, Jr. 1978. *Mechanisms that regulate the intensity of oxidation-reduction in anaerobic sediments and natural water systems.* Technical Report Y-78-11, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

EPA (U.S. Environmental Protection Agency). 1986. *Quality criteria for water*. Report 440/5-86-001, EPA, Washington, D.C.

Rinella, F.A., P.A. Medvick, D.R. Skaar, and D.E. Knight. 1994. *Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the Owyhee and Vale Projects, Oregon and Idaho,* 1990–1991. Water Resources Investigations Report 93-4156, U.S. Geological Survey, Boise, Idaho.

Internet Citations — [author(s) or agency; year; title; publisher; URL; month and year accessed]

Reyes, R. 2008. *Tracy fish photographs*. U.S. Bureau of Reclamation. http://www.usbr.gov/pmts/tech_services/tracy_research/photos/index.html. (January 2009).

Wikipedia. 2008. *Hydropower*. Wikimedia Foundation, Inc. http://en.wikipedia.org/wiki/Hydropower. (January 2009).

Personal Communication Citations — [author(s); year; affiliation; city; state (if necessary) or author(s); year; title; city; state (if necessary)]

Smith, D.M. 2007. Bureau of Reclamation, Fisheries and Wildlife Resources Group, Denver, Colorado, personal communication.

Goff, F.S. 2000. Fish Salvage Data for 1999 from the Hastings Salvage Facility. Hampshire, England, personal communication.

FORMAT AND PROCEDURES FOR TECHNICAL BULLETINS

Technical Bulletins are internet-only publications that are intended to quickly report important research findings and information or small studies that do not necessitate publication in the Tracy Series. Technical Bulletins must meet basic standards for scientific quality, and are reviewed by the TSE, RC, and TM. A draft is submitted to the TSE, who is the designated peer reviewer for Technical Bulletins. The TSE may assign an SE for a specialty outside his or her expertise. After revisions, the TSE performs final editing and formatting as a Technical Bulletin. Format for Technical Bulletins is similar to Tracy Series reports and Reclamation Visual Identity requirements; however, it may lack elements and details found in a formal Tracy Series report.

Once formatted, a PDF file is created and uploaded to the TFFIP website. Once uploaded and linked on the TFFIP website, the TM may initiate an official Reclamation press release though the Mid Pacific Region Public Affairs Office. Technical Bulletins are numbered sequentially using a year-number format (*e.g.*, 2008-3), and Reyes (2008) is a published example.

ACKNOWLEDGMENTS

This report is indebted to the TFFIP researchers who use creativity and hard work to help improve fish salvage at the TFCF, and whose work is at the heart of the Tracy Technical Report Series. The authors would also like to thank all federal and California state resource agency cooperators, research partners, and shareholders for their service as peer reviewers and program collaborators.

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ASCE (American Society of Civil Engineers). 2007. *Authors' guide to journals and practice periodicals.* American Society of Civil Engineers. http://ascedev.inforonics.com/authors/author_guide.htm. (September 2007).

ASTM (American Society for Testing and Materials). 2003. *E29-02 Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications, Volume 14.02*. American Society for Testing and Materials Book of Standards, West Conshohocken, Pennsylvania.

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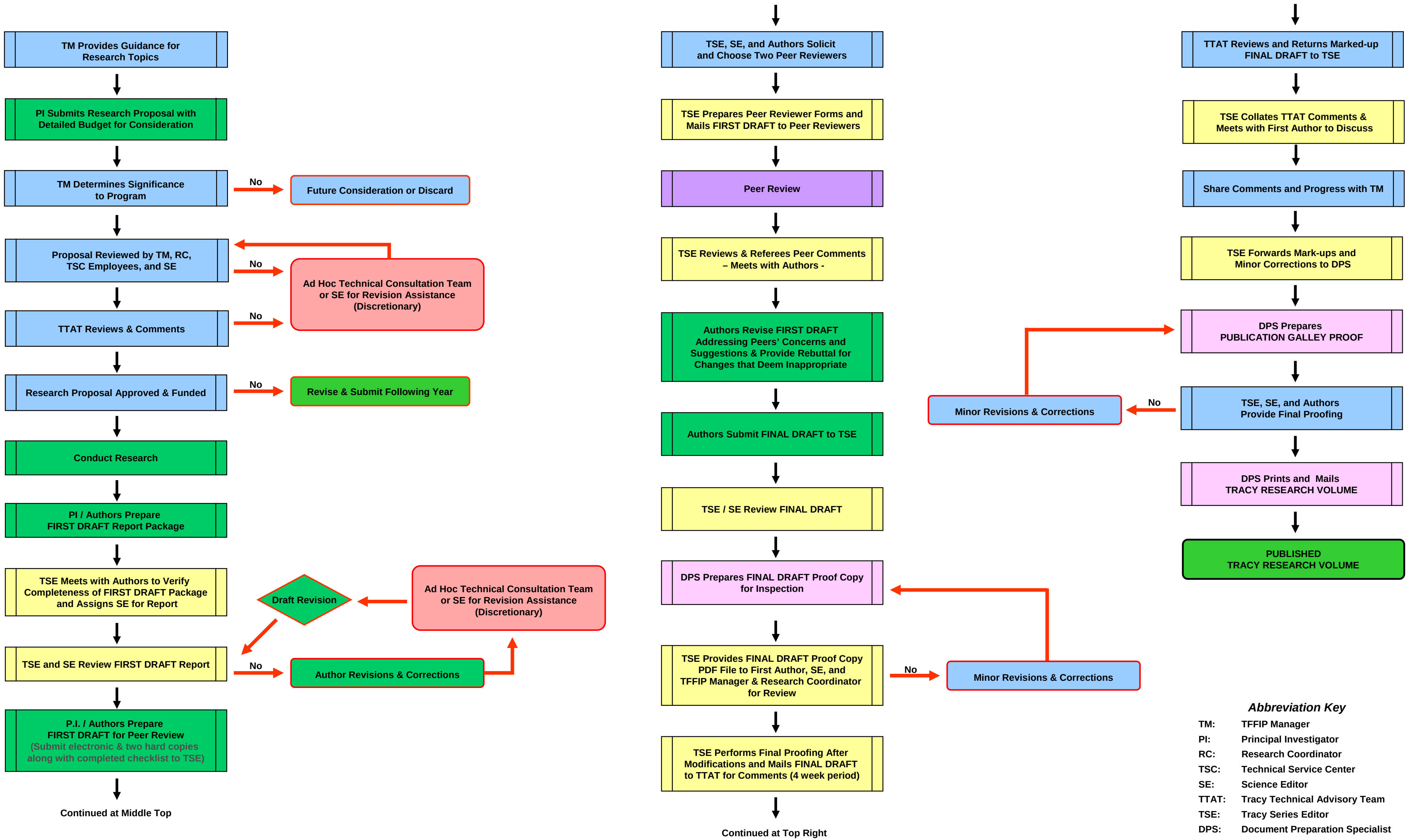
Appendices

Appendix 1

Flowchart for the Tracy Series Publication Process

Tracy Research Proposal & Report Publication Process



Abbreviation Key

TM:	TFFIP Manager
PI:	Principal Investigator
RC:	Research Coordinator
TSC:	Technical Service Center
SE:	Science Editor
TTAT:	Tracy Technical Advisory Team
TSE:	Tracy Series Editor
DPS:	Document Preparation Specialist

Appendix 2

Example of Research Proposal Layout

Holding-Duration-Associated Impacts of Salvaged Striped Bass and Green Sturgeon at South Delta Fish Collection Facilities

Principal Investigators

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Problem Statement

Population declines of several fish species throughout the West may threaten to disrupt water delivery systems. Water diversions are suspected of being one of the primary causes for the losses of fishes through entrainment (Brown and Moyle 1993, Bennett and Moyle 1996). California water officials halted water exports from the Sacramento-San Joaquin Delta in the spring of 2007 as a direct result of a lawsuit after rising numbers of endangered fish were thought to be killed. These federal- and state-listed threatened and endangered fish species, and those of concern because of an economically viable sport fishery or listed as a Pelagic Organism Decline species, are frequently recovered during salvage operations. Water is vital to the growth and prosperity of the American West and recent lawsuits from the California Department Fish and Game (CDFG) and environmental groups have dealt major blows to Delta water export. Water resource agencies will have to comply to tougher environmental standards in the near future and will have to lessen their impact on fish and wildlife, while providing water for agriculture and municipalities.

Operations of the U.S. Bureau of Reclamation (Reclamation) facilities at water diversions and dams require proper screening, passage, capture, and handling of fish. These functions are of major importance for the survival of fishes impacted by Reclamation; however handling stress associated with entrainment may inadvertently harm the fish that Reclamation is attempting to save. Exposure of fishes to environmental stressors, such as capture and handling, can be a great concern to fisheries biologists, in that extreme or prolonged stressors may plague fish performance and overall health, adversely affecting population size and sustainability. Measuring the physiological stress and potential direct and indirect mortality experienced by fishes during the different components of Reclamation operations is vital to understanding its negative impacts. Results of this proposed study and one we are currently finishing will provide information on methods to reduce the harmful effects of entrainment and handling, leading to a reduction in the incidental take of fishes and a reduction of direct and indirect mortality from sublethal stressors. The literature on the physiological effects of capture and handling stress on entrained or salvaged fish species through daily operations at Reclamation and other water resource agencies' facilities is scant and needs to receive more research attention.

Evaluations and improvements of both the state and federal fish salvage facilities have been ongoing for a number of years, though emphasis has been more on the facilities themselves rather than the operations for handling, transporting, and release of fishes (Liston *et al*. 2000). Efforts by CDFG have demonstrated problems with survival of salvaged fish after transport to the release site, and Reclamation researchers have contributed to the understanding of survivorship and injury of fishes associated with the collecting/holding tanks at the Tracy Fish Collecting Facility (TFCF; Raquel 1989, Karp and Lyons 2007). These studies, and ongoing technological advances in concepts related to fish holding, indicate an important need for accelerating and expanding studies at the two salvage facilities. Research and monitoring plans have been instituted to investigate the consequences that these water diversions are inflicting on Sacramento-San Joaquin River Delta fish fauna and ways to minimize their negative impacts.

Study Summary

Over the past 3 years, we have been studying the deleterious effects of the fish salvage process at the TFCF (Tracy, California) and in Reclamation's Hydraulics Laboratory (Denver, Colorado). We have examined holding tank design and fish removal and transfer methods, and how they relate to acute physiological stresses and potential direct and indirect mortality experienced by salvaged fishes (Portz *et al*. 2006). The next logical step and aim of our proposed study for FY 2008 is to examine the changes in the stress physiology of salvaged fishes during (and throughout) a normal holding period before they are removed to be transported back to the river for release. This will be accomplished by comparing changes in plasma constituents attributable to capture and handling stress of striped bass (*Morone saxatilis*) and green sturgeon (*Acipenser medirostris*) and how the concentrations of the plasma constituents changes over a holding duration. The research question being asked is how does the holding duration physiologically affect striped bass and green sturgeon (*ca*. 300 mm TL)?

Taking blood specimens from fish during physiological studies typically involves netting, handling, inducing anesthesia, and withdrawing a blood sample by syringe. Although simple and rapid, this procedure can result in a stress response by the fish and would limit repetitive blood sampling from the same individual, and removal of one animal can induce a stress response in other individuals in the same tank. Pickering *et al.* (1982) found that the sequence in which several fish from one tank were sampled had a significant influence on plasma cortisol levels. In addition, single measurements of plasma cortisol are merely instantaneous snapshots of a much larger dynamic process over time. The use of indwelling catheters is recommended to minimize disturbances during sampling (Heisler 1984) and gain insight to the physiological changes throughout fishes' holding durations.

Objectives

The objectives of this study are: 1) to determine if stress exhibited in held fish is affected by the duration detained; 2) to evaluate caudal vessel cannulation as a viable alternative to handling, netting, and anesthetizing fish for blood sampling during salvage processes; and 3) to evaluate serial blood sampling as a technique to determine physiological stress responses in fish over time.

Hypothesis

We hypothesize that the cylindrical collecting/holding tanks at salvage facilities in the south Delta significantly alter stress-related blood constituents. Stress exhibited in held fish is affected by the duration detained; fish collected and detained for extended periods of time (*e.g.*, >6 h, but <48 h) will show plasma constituents returning to basal levels during the holding period. Arguably, it might be beneficial to hold fishes for longer periods of time during salvage practices to provide them with an opportunity to reduce the effects of stress after being louvered and diverted into holding tanks and before loading them in tanker trucks for transport to release sites. In order to hold fish longer, the TFCF would have to 1) remove stressors from the holding tanks, and 2) obtain a new Biological Opinion (Fish and Wildlife Service with concurrence from CDFG) to allow a holding period longer than 8 h for delta smelt (*Hypomesus transpacificus*) and 12 h for Chinook salmon (*Oncorhynchus tshawytscha*). Results from this study and those from prior research focusing on holding-associated stress of Chinook salmon may be useful for extending holding periods for other species of interest.

Materials and Methods

Source and Care of Fish

Striped bass and green sturgeon (*ca*. 300 mm TL) will be obtained from the TFCF. Fish will be cannulated and allowed 24 h to recover from the handling stress associated with inserting the cannulae prior to experiments. Striped bass and green sturgeon will be used in this study because Chinook salmon and delta smelt entrained at the TFCF are too small for cannulation and serial blood sampling. Studies in Denver will require fish to be transported and held in the Fish and Wildlife Resources Group Aquaculture Facility. Experimental fish will be maintained in 757-l circular tanks equipped with an aerated, partial recirculating water system to deliver water continuously along with dechlorinated, air-equilibrated municipal water. Water temperatures will be maintained at 18 ˚C. Fish will be held under a natural photoperiod (38° N latitude) and supplemented with halogen lights, and will be fed BioOregon (BioOregon, Inc., Longview, Washington) semi-moist pellets at 1.5–2% body weight per day or live minnows.

Cannulation Procedure

Striped bass and green sturgeon will be cannulated in the caudal vessel. Fish will be anesthetized with a 200-mg/L tricaine methanesulfonate solution (MS-222, Argent Chemical Laboratories, Inc., Redmount, Washington) and placed on a V-shape surgical table. Anesthesia is maintained and gills continuously irrigated with a MS-222 solution (100 mg/L) during the operation at a rate of 1,500 ml/min using a submersible pump. A 75-mm-long, 17-gauge, hypodermic needle is inserted through the skin and musculature to the hemal canal and a 200-cm-long cannula (Clay Adams PE-50 tubing, Division of Becton Dickinson, Parsippany, New Jersey) will be inserted through the needle into the caudal vessel (non-occlusive cannulation). The cannula tubing will be filled with heparinized saline, distal end plugged with a straight pin and painted (to differentiate individual fish), and sutured (Ethicon 3-0 silk) to the skin at the point of entry at the lateral aspect of the body wall. Two syringes attached to a three-way stopcock are connected to the distal end of the cannula, which enables undiluted blood samples to be collected. The cannula is refilled with heparinized saline after each blood sample. Surgical cannula placement and recovery from anesthesia will be completed within 10 min. Rapid (<5 min) recovery will be initiated by switching artificial ventilation to aerated, anesthetic-free water. Once ventilatory activity returns, the fish will be placed into a 757-l recovery tank receiving a continuous flow of aerated, dechlorinated water. Fish will be allowed 24 h to recover and allow stress-related plasma constituents to return to pre-handling levels.

The Experiment: Effects of holding duration on the stress response salvaged fishes

Tests are to be performed at both the TFCF and the laboratory simulation TFCF tank in Denver. Three cannulated fish are released in the collecting/holding tank. The cannula is hooked and slowly maneuvered where a blood sample may be taken without disturbing the fish. Blood samples (0.5 ml) will be collected via the cannula at intervals of 0, 1, 2, 4, 8, 12, and 24 h. A control fish remaining in the 757-l tank is bled (0.5 ml) at 0 and 24 h. Not all samples are drawn from every fish. No more than three blood samples are drawn from any one fish. This protocol ensures blood hemoglobin concentration which is directly proportional to intracellular buffer capacity (Davenport 1974, Crocker and Cech 1998).

Plasma Analysis

Blood is immediately centrifuged (Clay-Adams Autocrit Ultra3, Becton Dickinson Diagnostics, Sparks, Maryland) for 4 min at 12,000 x ***g*** to separate the plasma from the packed cells. Plasma obtained from each fish is transferred into plastic cryogenic freezing vials and temporarily stored in a 10-l liquid-nitrogen dewar flask (-196 ˚C). These samples are then transferred to a -80 ºC freezer for storage and later analyses. Plasma is later thawed for plasma cortisol, lactate, and glucose measurements. Plasma cortisol concentrations are measured using a modified enzyme immunoassay (ELISA; Munro and Stabenfeldt 1984, Munro and Stabenfeldt 1985, Barry *et al*. 1993). Plasma lactate and glucose are measured with a polarographic analyzer (YSI 2700 Select, Yellow Springs, Inc., Yellow Springs, Ohio).

Data Analyses

Statistical analyses will be performed using SAS 9.1 (SAS Institute, Inc., Cary, North Carolina) and Sigmastat 3.0 (Jandel Scientific, San Rafael, California) statistical software packages. Differences between treatments and controls are tested using an unbalanced 2 x 9 factorial design random complete block design (RCBD) analysis of variance (ANOVA) with each group of the nine durations constituting a block, blocks nested within hours with hours fixed (Steel *et al*. 1997). Plasma constituent data will be analyzed either by using RCBD factorial ANOVA, one-way analysis of variance, or two-way analysis of variance with durations as a factor (Zar 1984, Steel *et al*. 1997). The Tukey's test will be used for all pair-wise multiple comparisons for parametric data. The

Shapiro-Wilk's test for normality and the Levene's test for homogeneity of variances are used to determine ANOVA assumptions. Data that do not meet the assumptions of ANOVA and are unable to be power or log transformed will be compared using a Kruskal-Wallis non-parametric analyses of variance on ranks with the Dunn's test for pair-wise multiple comparisons (Zar 1984, Steel *et al*. 1997). Differences were considered significant at $P < 0.05$.

Assumptions/Study Limitations

Access to collecting/holding tanks onsite at TFCF poses a significant obstacle during final stages of construction. In addiction, maintaining a swirl for up to 24 h may be difficult to accomplish due to logistical limitations, presence of species of special concern, and incoming high fish densities. The logical alternative might be the Denver Hydraulics Laboratory—a well-equipped research facility. However laboratory experiments are meant to simulate field conditions as closely as possible while maintaining additional control of environmental variables. Needless to say, it is impossible to completely duplicate all conditions that are experienced onsite.

Significance

Water diversions have been implicated as one of the primary causes of decline in California's fish fauna (Stevens *et al*. 1985, Bennet and Moyle 1996). Current information on the effects of the capturing and holding processes on the survival of threatened and endangered species is needed to improve their survival during this process. Results of this study will provide information on methods to reduce the harmful effects of entrainment and holding, leading to a reduction in the incidental take of fishes and a reduction of indirect mortality from sublethal stressors. Loss of fishes due to entrainment into water diversions is a problem throughout the world. Refined fish screening methods and improved holding practices implemented at the TFCF will lead fisheries biologists and engineers to make substantial advances in the reduction of entrainment and successful fish salvage at other water diversions. Our study will provide valuable information to refine fish salvage methods in a cost-effective manner, while providing methods to lower Operation and Maintenance costs.

Coordination and Collaboration

This study is a continuation of a collaborative effort between Reclamation, CDFG, and California Department of Water Resources (CDWR). We would like to link these experiments to research currently underway by the Collection, Handling, Transport, and Release (CHTR) studies. This project lends an excellent opportunity for enhancing cooperative interagency efforts, leading towards minimizing salvage-facilities-associated fish mortalities in the future. Regularly scheduled meetings [Tracy Technical Advisory Team (TTAT) and CHTR], at least once a month, will continue to be held to facilitate interagency coordination of research activities. This study will be coordinated with the Fisheries and Wildlife Resources Group, Denver Water Resources Laboratory, TFCF Staff, CDFG, CDWR, other researchers, and the interagency TTAT.

Resources and Capabilities

The Fisheries and Wildlife Resources Group provides a diverse range of expertise that includes staff with knowledge of fish biology, physiology, and aquaculture. The Denver Federal Center has excellent research facilities and space needed to study physiological stress associated with holding duration in collecting/holding tank. The Denver Hydraulics Laboratory also contains a replica TFCF collecting/holding tank available for experiments formerly used by other fish physiological stress studies.

Endangered Species Concerns

This study will not involve handling or capturing endangered or threatened species. Species will include fishes commonly entrained and of special concern to the TFCF: striped bass and white catfish (*Ameiurus catus*). Neither fish is listed as threatened or endangered pursuant to both the Federal Endangered Species Act and California Endangered Species Act. Applicable state and federal permits will be (have been) obtained to conduct research with these species (California Scientific Collecting Permit 801159-05, Colorado Importation License and Aquaculture Permit 051MPT014). No fish will be sacrificed intentionally during this study, and the fish used in the experiments may be released after such use if allowable by law.

Dissemination of Results (Deliverables and Outcomes)

The primary deliverable from this proposed study will be articles published in both the Tracy Volume Series and a peer-reviewed scientific journal. Technical updates may also be provided at TTAT and CHTR meetings, along with posters and oral presentations given at scientific forums in late summer/fall 2008. Additionally, information will be gained on the successes and limitations of the fish collection and salvage process at the TFCF. This knowledge will help guide future improvements in the fish collection, holding, and transport process.

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Budget

Research (2 biologists)	
8 weeks	$40,320
Prep/set-up/construction	$ 3,360
Fish transport (1 trip to CA for 2 biologists, 4 days roundtrip)	
Fuel/travel/salary	$ 7,830
Fish Care	
Salary (1h/day for 60 days)	$ 2,400
Food (pellet and live food)	$ 600
Prophylactic treatment/salt	$ 600
Supplies	
Polarographic analyzer supplies	$ 560
UC Davis Endocrinology Lab	$ 1,400
Cannulation supplies	$ 1,350
Miscellaneous	$ 500
Data Analysis/Report	
Salary (2 weeks)	$6,080
Publication costs (scientific journal)	$ 1,000
Total	$66,000

Appendix 3

Forms for Authors and Reviewers of Tracy Series Reports

First Draft Checklist for Tracy Series Authors

Manuscript Title:

Authors:

	Item	***Date Completed***
1	TFFIP Manager (TM) and Research Coordinator (RC) Project Approval	
2	Good Scientific Practices Followed	
	Experimental Design Adequate to Answer the Question	
	Statistics Appropriately Explained and Applied	
	Measurement Units Correctly Used	
	Significant Figures Applied Throughout	
	Pertinent Information is Referenced Appropriately	
	Tracy Reference Style Used Throughout	
3	Rough Draft Completed	
	Spell Check and Revise	
	Grammar Check and Revise	
	Abbreviations or Pseudonyms Follow First Usage	
	Abbreviations Used Consistently After Definition	
	Metric Units First (English Equivalent in Parentheses, if necessary)	
4	Co-Author Review and Revision	
	Informal Technical Review by Authors	
	Revisions Incorporated into First Draft	
5	Tracy Series Editor (TSE) and Science Editor (SE) Approval	
	Review by TSE and/or SE for Proceed or Revise Decision	
	Formal Copy Editing and Revision – ONLY IF NEEDED	
	Statistics Consultation - ONLY IF NEEDED	
	Consult with TSE on Figures, Tables, and Peer Reviewers	

	Item	***Date Completed***
6	Approval by TSE and/or SE for Submission	
7	Tracy Report First Draft and GPO Style Conformance	
	Title Page Formatted Correctly	
	ABSTRACT + NTIS Search Terms and Key Words	
	TABLE OF CONTENTS (Without Page Numbers)	
	Table and Figure Captions in Table of Contents	
	EXECUTIVE SUMMARY	
	Headings and Subsection Standards Followed	
	INTRODUCTION Includes Program Summary Study Purpose	
	METHODOLOGY	
	RESULTS and DISCUSSION	
	All INSERT TABLE HERE notations follow first mention in text	
	All INSERT FIGURE HERE notations follow first mention in text	
	CONCLUSIONS	
	ACKNOWLEDGMENTS	
	REFERENCES - Alphabetical Using Tracy Series Standard	
8	Peer Reviewers Identified by Authors for TSE	
9	TSE Contacts Peer Reviewers	
10	Authors Provide an Electronic and Two Printed Copies of FIRST DRAFT to TSE	
11	FIRST DRAFT Manuscript Mailed to Peer Reviewers by SSE	

PEER REVIEWER SUMMARY SHEET

Tracy Series Technical Reports

Tracy Fish Facility Improvement Program - Tracy Fish Collection Facility

Received: ___________________

Title: ____

Author(s): ____

Peer Reviewer: ______________________________ Telephone: ______________________________

Address: ___________________________________ Email: __________________________________

____

Dear Reviewer:

The attached manuscript is under consideration for publication as Volume ______ in the Tracy Technical Report Series. In order to maintain our publication schedule, we ask that you complete your review by __________. Please complete the review, respond to the questions below, and return the manuscript with any margin comments and/or additional comments to the editor. If you would prefer this form in an electronic format, or have additional questions, please contact the editor. Thank you for your assistance in this important task.

Donald E. Portz, Tracy Series Editor
USDI - Bureau of Reclamation
PO Box 25007, 86-68290 dportz@do.usbr.gov
Denver, CO 80225 303-445-2220 office, 303-859-9505 cell

GENERAL COMMENTS (attach additional pages if necessary)

1. Does the research work meet standards of good scientific practice (*i.e*., scientifically and technically sound)?

2. Does the title clearly reflect the contents of the paper? Is the abstract informative? Are the objectives clearly stated? Is the methodology comprehensive?

3. Are conclusions in the manuscript supported by data and results?

4. Is the manuscript clearly written? If not, is the main problem organization? grammar?

5. Are graphs and figures clear and are statistics applied and interpreted correctly?

6. Are measurement units and significant figures used correctly?

7. Do you recommend minor or major revisions prior to final distribution as a Tracy Series Volume? Please provide details:

8. How could the manuscript be improved (please refer to page and paragraph number from the draft manuscript)?

Appendix 4

Example of First Draft Layout

First Draft Manuscript – Do Not Cite 21-point

Tracy Fish Facility Studies California 21-point

Changes in Water Quality During Fish-Hauling Operations at the Tracy Fish Collection Facility 18-point

Tracy Technical Bulletin 2008-2 16-point

By 12-point

Zachary A. Sutphin[1] and Brandon J. Wu[2] 12-point

U.S. Department of the Interior 12-point
Bureau of Reclamation
Mid-Pacific Region
Denver Technical Service Center

This is the cover sheet for the body of the manuscript

1.25-inch left and right margins, Arial Font
Capitalize each word in title except for prepositions (at, the, of, a, an, etc.)

[1]Bureau of Reclamation 10-point
Technical Service Center
Fisheries and Wildlife Resources Group, 86-68290
PO Box 25007
Denver, CO 80225-0007

[2] Bureau of Reclamation
Tracy Fish Collection Facility; TO-410
16650 Kelso Road
Byron, CA 94514-1909

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ABSTRACT

A short-term pilot study was conducted between June 2005 and 2006 to measure the effects of fish density on important water quality parameters during fish transport in fish-hauling trucks from the U.S. Bureau of Reclamation's Tracy Fish Collection Facility (TFCF; Byron, California). Fish density (0.3–64.5 g of fish/L) and water quality parameters of concern during the transport of fish generally remained within acceptable ranges over the duration of our study. Ranges of temperature, dissolved oxygen (DO), free hydrogen ion activity (pH), total ammonia nitrogen (TAN), and percent total gas saturation (TGS) were 15.2–25.3 ^{o}C), 5.8– >19.0 mg oxygen/L, 6.5–7.9 standard pH units, 0.2–2.0 mg TAN/L, and 101–106% TSG, respectively. On one occasion, fish transport densities were above recommended guidelines (64.5 g of fish/L), and resulted in elevated carbon dioxide (CO_2) levels of 20 mg/L. However, the efficiency of the transport truck oxygenation system maintained DO levels above saturation, and therefore counteracted the possible negative effects of mild hypercapnia. Data collected from this study support the continuation or redevelopment of a large-scale TFCF fish-hauling truck water quality monitoring program.

Key words: Water quality, fish-hauling, transport, density, hypercapnia, Tracy Fish Collection Facility, dissolved oxygen, pH, TAN, TGS

INTRODUCTION

Water quality can affect the success of fish transportation; adverse conditions impair important physiological processes, ultimately affecting health, and reducing fish performance and survival (Moyle and Cech 2004; Portz *et al*. 2006). Water quality at the onset of transportation is a necessary consideration; it is easy to obtain, provides baseline levels, and is an indication of how much change is acceptable before individual parameters reach unhealthy or critical levels. However, water quality changes throughout transport, and the subsequent levels at the end of transport should be the primary consideration when establishing appropriate fish transportation methodology.

Water quality parameters of particular concern during transport operations are temperature, dissolved oxygen (DO), carbon dioxide (CO_2), free hydrogen ion activity (pH), and total ammonia nitrogen (TAN) levels. Fish require DO for survival, as it is the primary component for all aerobic activity and cellular metabolism (Moyle and Cech 2004, Portz *et al*. 2006). However, oxygen consumption in closed systems during transport effectively removes necessary oxygen, and if oxygen production systems do not meet or exceed consumption demands, hypoxic (low oxygen level) and anoxic (no oxygen) conditions will develop. Low oxygen levels can result in respiratory stress, which can affect swimming performance, equilibrium, and survival (Moyle and Cech 2004, Herbert and Steffensen 2005, Portz *et al.* 2006). As a byproduct of metabolic processes, fish produce CO_2 ($\approx$ 1.4 mg CO_2 per 1.0 mg O_2 consumed under aerobic conditions), which can threaten fish health in transport containers as elevated levels are toxic to fish and can result in hypercapnia and respiratory distress (Colt and Tchobanoglous 1981, Wedemeyer 1996, Cech and Crocker 2002). Elevated CO_2 also functions in lowering water pH and creating acidic conditions, which affects ion transport at gills and leads to blood acidosis (Wood and McDonald 1982, Wedemeyer 1996). Also of concern during fish transport are the effects of elevated ammonia. Ammonia can reach toxic levels in closed transport systems, as fish continuously produce TAN as a primary byproduct of protein metabolism (*e.g.*, processing of food) and water consumption. Of particular concern during transportation is the portion of un-ionized ammonia (NH_3^+), which increases with increasing temperature, salinity, and pH. Un-ionized ammonia is extremely toxic to fish, and can result in loss of equilibrium and eventual fish mortality (Russo and Thurston 1991). However, what determines the level of toxicity of parameters such as CO_2, TAN, and pH is their concentration in transport media. Therefore, obtaining an accurate estimate of water volume during transport is a critical factor when developing appropriate densities of fish for transport (for a complete review on the effects of water quality on fish during holding see Colt and Tomasso 2001 and Portz *et al*. 2006).

Operations at the U.S. Bureau of Reclamation's (Reclamation) Tracy Fish Collection Facility (TFCF; Byron, California) facilitate the removal of fish from water leading to the Bill Jones Pumping Plant, and via fish-hauling practices, provide them with relocation away from the influence of the pumping plant, effectively limiting their likelihood of entrainment and pump associated mortality (Figure 1). Such operations result in transportation of millions of fish annually, including over 50 species of fish, with

Insert Here **** FIGURE 1.—Map of the Sacramento-San Joaquin Delta depicting the Tracy Fish Collection Facility, Bill Jones Pumping Plant, and Emmaton Fish Release Site.**

threatened delta smelt (*Hypomesus transpacificus*) and endangered winter-run Chinook salmon (*Oncorhynchus tshawytscha)* contributing to the composition of species effected (Brown *et al*. 1996; http://www.delta.dfg.ca.gov/Data/Salvage/).

During routine TFCF operations, fish are salvaged into flow-through holding tanks (Figure 2) that are 6.1 m in diameter and 4.7 m deep (volume ranges from ≈ 17,000–70,000 L and is dependent on tidal fluctuations) that provide continuous flows of water (at velocities between 0.03 and 0.03 m^3/s and are maintained for up to 8 h until they

Insert Here **** FIGURE 2.—Side view (left) and top view (right) of the Tracy Fish Collection Facility holding tanks used to support fish after collection and prior to hauling…**

can be loaded into a TFCF fish-hauling truck (Figure 3) and transported from the southern Sacramento-San Joaquin Delta (SSJD) for release at one of two Reclamation release sites in the central SSJD (Figure 1). Two important stages during this process are fish loading and fish transport. Fish loading consists of draining the holding tank over an approximate 10-min period, thus restricting contents (*e.g*., fish, debris, garbage) to 1,400 L of water. Holding tank contents are then drained into a fish haul-out bucket (Figure 4) of equal volume and transferred to a fish-hauling truck. Given the increased density of fish during transfer from holding tank to truck, likelihood of brief exposure (≈ 10 min) to hypoxic conditions increases, making loading a possible water quality limited stage likely to affect health of transported fish. Fish transport consists of hauling fish in a closed (*e.g*., no additional water provided throughout transport) cylindrical tank (1.2 m deep, 4.4 m long) that provides continuous pure DO via oxygen diffusing air stones over a maximum distance of 49.9 km. Because of the closed nature of the hauling system, depletion of available DO and accumulation of ammonia and CO_2 are a concern and could potentially lead to harmful conditions for fish.

Insert Here **** FIGURE 3.—The Tracy Fish Collection Facility fish-hauling truck. The tank is cylindrical in shape, 1.2 meters deep, 4.4 meters long.**

Insert Here **** FIGURE 4.—The Tracy Fish Collection Facility fish haul-out bucket.**

The objectives of this study were threefold: (1) measure changes in the following water quality during transport: temperature (°C), DO, CO_2, pH, TAN, and total gas saturation (TGS), and measure how these changes were affected by estimated fish densities in the hauling truck; (2) measure the time it takes from fish loading to fish release, and (3) measure water loss (changes in volume) during transport.

METHODS

Hauling Truck Water Quality

Water quality was measured during loading, transport, and release stages of the TFCF fish transportation process. Sampling was conducted weekly between June and September 2005, with one additional sample collected in November 2005, and two additional samples collected in June 2006. The sampling period was selected as it coincides with the period of warmest water temperatures in the southern SSJD and, as a function of the thermal affects on fish metabolism (in general, metabolism increases with temperature), likely resulted in highest oxygen consumption, as well as CO_2 and TAN production rates.

Water quality was measured at four stages during the loading, transport, and release process: (1) in the holding tank prior to loading (°C only); (2) after loading, but prior to transport in the hauling truck; (3) after transport, but prior to release, in the hauling truck; and (4) at the most commonly used release site (Emmaton Release Site, Emmaton, California; Figure 1). An 18.9-L bucket was used to sample water from the surface of the holding tank prior to transport. Water quality measurements in the fish-hauling truck were taken at ≈ 50% water depth. Samples were collected at the release site 38 m offshore and at the water's surface, except for temperature, which was also recorded at the following depths off bottom: 1.5, 4.6, and 7.6 m.

Temperature and DO were measured at each stage using a pre-calibrated YSI meter (Yellow Springs, Inc., Yellow Springs, Ohio); CO_2 was measured using a drop count titration kit (CHEMetrics, Inc., Calverton, Virginia); pH was measured using an Oakton pH meter (Vernon Hills, Illinois); TGS was measured using a saturometer (Sweeney Aquametrics, New Haven, Connecticut); TAN was measured using a water quality test kit (LaMotte Company, Chestertown, Maryland); and NH_3^+ was calculated using tables provided by Wedemeyer (1996), and incorporating TAN, pH, and temperature data collected during our study.

Truck Water Loss

Manufacturer details provided TFCF fish-hauling truck tank dimensions and maximum water capacity (8,000 L). However, filling the truck to maximum capacity is not a common practice at the TFCF, and the truck tank is not completely sealed during hauling, resulting in water loss during transport. To obtain an accurate estimate of water volume (and subsequent water volume loss during transport) as a function of depth, 1 L of yellow-green dye (Bright Dyes, Miamisburg, Ohio; maximum absorbance = 490/520 nanometers) was injected into known water levels within the TFCF haul truck, and water samples were taken at each of the following depths below tank surface: 51, 38, 25 and 13 cm. Water samples were analyzed using a spectrophotometer, absorbance was measured, and water volumes were calculated at each depth. Similar methods were employed to determine the volume of water for both TFCF fish-count and fish-loading buckets.

Oxygen Production Rates

The TFCF fish-hauling system employs the use of microbubble oxygen diffuser air stones (70 by 8 cm, MBD 600, Point Four Systems, Inc., Coquitlam, British Columbia), which, when operated at full capacity are capable of providing 18 L/min of pure oxygen to the water. To test this assumption and the TFCF fish-hauling tank oxygenation system, oxygen cylinders were set to 40 psi, and flow meters controlling O_2 flow to tank air stones were set to 18 L/min. Water level in the truck was adjusted to 25.4 cm below the tanks surface (6,804.6 L). A blower was attached to the TFCF haul-truck ventilation system, and the truck water was mixed in order to mimic possible cooling effects associated to wind passage and sloshing during driving. DO (mg/L) and temperature (°C) were recorded using a YSI 85 meter every 15 min over a 75-min period.

Fish Densities

Densities of fish during each transport were estimated from series of 10-min entrainment sub-samples taken at 2-h intervals prior to each transport. During 10-min entrainment sub-sampling, all fish entering the holding tank were salvaged, counted, identified to species, and the first 24 individuals of each species were measured for fork length. These data were then extrapolated (multiplied by 12) to estimate the number of fish passing into a holding tank over each 2-h period. Fish weights, necessary to establish densities during transport, were determined by establishing length-weight regression relationships for individual species of fish sampled from holding tanks.

Results and Discussion

Mean transport duration and distance over the length of our study were 59.4 min and 49.9 km, respectively (n = 19; distance and duration reported as function of a one-way trip). However, mean time from the point at which the holding tank was completely drained to the release of all fish at the release site was 79.8 min. During typical fish loading, spectrophotometer estimates indicate fish are transferred from holding tank to truck in a haul-out bucket containing a mean water volume of 1402 L. It should be taken into consideration that our measurements were conducted using a haul-out bucket void of fish and debris, and the addition of fish and debris will displace water. This relationship is important, because increased densities of fish (and debris) in the fish haul-out bucket can displace a significant volume of water, which is lost through haul-out bucket screens, ultimately reducing the volume of water available for fish. Therefore, increased confinement of fish in the haul-out bucket and smaller water volume from which available oxygen can be removed, results in elevated rates of oxygen consumption leading to rapidly deteriorating water quality. TFCF fish-hauling truck tanks, filled to capacity, hold 8,097 L of water, although the mean volume at the onset of transport was 6,691 L (equivalent to 24.6 cm below the top of the tank; Figure 5). Water loss throughout transport (mean = 147 L was not as significant as initially suspected and resulted in a mean post-transport volume of 6,544 L.

Insert Here **** FIGURE 5.—Tracy Fish Collection Facility fish-hauling truck tank water volume as a function of water depth below tank surface; measured as depth from top of tank to water surface.**

Total number of fish, and haul-out bucket and truck tank densities ranged from 372–503,319 fish, and from 1.3–86.6 and 0.3–65.4 g of fish weight/L, respectively (Table 1). However, the mean number of fish and density in the transport truck were 45,279 fish and 8.6 g/L, respectively. Only two samples contained >100,000 fish, indicating the majority of our post-transport water quality conditions are a function of low fish densities during transport. The majority of species transported during the study were Sacramento splittail (*Pogonichthys macrolepidotus*; ST; 68%) and fish labeled as “others” (21%), but the high numbers of both species can primarily be attributed to two large truckloads of common carp (*Cyprinus carpio*; 170,000 individuals) and ST (552,000 individuals) on June 7 and 14, 2006 (Table 2). Removing these two samples from the analysis, threadfin shad (TFS; 64%) contributed to the majority of species transported (n = 17).

Insert Here **** TABLE 1.—Percentage of species transported, mean number, and density of fish transported.**

Insert Here **** TABLE 2.—Maximum and minimum water quality levels observed in the Tracy Fish Collection Facility fish-hauling truck and at the Emmaton Release Site. Water quality levels were monitored between June 2005 and June 2006.**

Range of water temperatures (15.2–25.3 °C), DO (5.8– >19.0 mg/L), pH (6.48–8.66), and NH_3^+ (0.002–0.01 mg/L) throughout all stages of sampling remained within acceptable limits for long-term fish culture as recommended by Wedemeyer (1996), and are therefore deemed adequate for short-term transport of fish (Table 2). Once loaded into the fish-hauling truck, maximum increases (+ 0.9 °C) and decreases (- 0.8 °C) in water temperature during transport were not significant enough to pose serious health or performance risks to fish (Table 3). However, maximum differences in temperature from holding tank to post-transport in the hauling truck tank (- 1.9 °C and + 1.3 °C), and from holding tank to the fish release site (- 4.6°C and + 1.3 °C) in particular, are above recommended rates of thermal acclimation and may result in mild thermal stress and

Insert Here **** TABLE 3.—Changes in water temperature (ΔT) experienced by fish during the Tracy Fish Collection Facility loading, hauling, and release procedures.**

affect the ability of fish to escape predation upon release (Coutant 1973, Webb and Zhang 1994, Summerfelt *et al*. 2001; Ward and Bonar 2003).

The highest density of fish 65.4 g/L or 9.2 g/m^3 observed during sampling is above recommended guidelines 50 g/L for short-term transport (<3 hr; Carmichael *et al*. 2001). Regardless, DO levels increased throughout transport (from 9.0–15.3 mg/L) at the highest density, indicating the TFCF fish-hauling truck oxygenation system is capable of providing DO at a rate (1281.5 mg/min at 24.1 °C) that will support high densities of fish. TAN levels during transport densities of 65.4 g/L reached 2 mg/L and, if paired with elevated pH (basic) and water temperature, could result in toxic levels of NH_3^+. However, CO_2 production, resulting in levels of 20 mg/L counteracted the toxic effects of ammonia. Elevated CO_2 resulted in a drop in pH (6.48), which in turn reduced the proportion of the toxic form of ammonia to safe levels (NH_3^+ = 0.002 mg/L). Though elevated CO_2 levels effectively reduced the proportion of toxic NH_3^+ in the transport media, levels >10 mg/L are not recommended for fish culture and may have an adverse affect on fish during short-term transport. Wedemeyer (1996) reports CO_2 levels >20 mg/L can be detrimental to salmonids and other sensitive cold-water species. However, mortality, as a function of blood acidosis, is typically not common until CO_2 levels >100 mg/L are observed (Wedemeyer 1996). Moderately high CO_2 levels (20–40 mg/L) result in mild hypercapnia, reducing the oxygen carrying capacity of blood hemoglobin, and the ability of blood to transport oxygen to tissues (Wedemeyer 1996). However, during high fish densities and elevated CO_2 levels during transport, the TFCF fish-transport truck oxygenation system maintained oxygen levels above saturation, effectively limiting the negative effects of mild hypercapnia.

Though the highly productive and efficient truck oxygenation system functions in supplying adequate DO levels to support high densities of fish, the system is adjusted to operate at maximum capacity and not regulated as a function of fish density. Operating the truck oxygenation system at full capacity resulted in a maximum TGS level of 106.1% during testing. This value is likely lower than typically observed during transport because TGS was only measured on two occasions, and on both (June 7 and 14, 2006), densities of fish were high. During the transport of low densities of fish (<8 g/L) DO levels were commonly >18 mg/L and, it is plausible during such conditions TGS could reach levels above those recommended for fish culture (>110%; Wedemeyer 1996). Elevated TGS levels can lead to gas bubble disease, the formation of gas bubbles in the heart and other areas of the circulatory system, which ultimately leads to fish mortality.

RECOMMENDATIONS

Wedemeyer (1996) indicates that TGS levels >110% will eventually lead to gas bubble disease. It is therefore important that additional TGS samples be recorded at low fish densities and high DO production rates to estimate maximum levels of TGS during transport. This is particularly important at the TFCF because threatened and endangered species, such as delta smelt, Chinook salmon, and steelhead trout are commonly salvaged during seasons when more common species are in low abundance, and are therefore transported at lower densities (R. Reyes, 2008, personal communication).

We also recommend the initiation of water quality monitoring in the fish haul-out bucket. We estimated very high fish densities (up to 86.6 g fish/L in the haul-out bucket, and though exposure time is minimal (≈ 10 min), there is a possibility of hypoxic exposure and rapid deterioration of other important water quality parameters over a short-time interval.

Two fish-hauling truck water quality samples were obtained at transport densities of >17 g fish weight/L. High densities of fish during transport lead to deteriorating water qualities, which pose a threat to fish health. We recommend additional samples be acquired during periods of warm temperatures and high fish salvage to increase sample size and improve the reliability of our estimates.

ACKNOWLEDGMENTS

We would like to thank Joel Imai and the TFCF Fish Diversion Workers for allowing us to interrupt daily activities and participate in daily fish transportation events. We are grateful to Brent Bridges for providing technical support, and Don Portz, Ron Silva, and Kathleen Baker for their editorial review. Finally, we would like to thank Ron Silva for providing general study oversight and Reclamation's Mid-Pacific Region for funding.

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TABLES *21-point*

Changes in Water Quality During Fish-Hauling Operations at the Tracy Fish Collection Facility *18-point*

Tracy Technical Bulletin 2008-2 *16-point*

By *12-point*

Zachary A. Sutphin[1] and Brandon J. Wu[2] *12-point*

This is the cover sheet for the tables – attach tables behind this sheet including captions at the top of each table, one table per page (where feasible).

List tables as seen above – copy and paste into TABLE OF CONTENTS.

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TABLE 1.—Percentage of species transported, mean number, and density of fish transported.

Species	Percent of Totals
Sacramento splittail (*Pogonichthys macrolepidotus*)	69%
Others—primarily common carp (*Cyprinus carpio*)	21%
Threadfin shad (*Dorosoma petenense*)	7%
White catfish (*Ameiurus catus*)	1%
Striped bass (*Morone saxatilis*)	1%
American shad (*Alos sapidissima*)	<1%
Channel catfish (*Ictalurus punctatus*)	<1%
Combined centrarchids	<1%
Chinook salmon (*Onchorhynchus tshawytscha*)	<1%
Steelhead (*Onchorhynchus mykiss*)	<1%
Yellowfin goby (*Acanthogobius flavimanus*)	<1%
Delta smelt (*Hypomesus transpacificus*)	0%
Mean number of individuals transported	**45,279**
Mean fish transportation density	**8.6 g of fish/L**

TABLE 2.—Maximum and minimum water quality levels observed in the Tracy Fish Collection Facility fish-hauling truck and at the Emmaton Release Site. Water quality levels were monitored between June 2005 and June 2006.

	Pre-Haul		**Post-Haul**		**Release Site**	
Water Quality Parameter	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**
Temperature (°C)	25.3	15.2	25.1	15.8	23.0	15.2
Dissolved oxygen (mg/L)	12.9	6.7	>19.0[1]	5.8	10.9	7.4
Carbon dioxide (ppm)	0.0	0.0	20.0	0.0	n/a	n/a
pH (standard units)	7.8	7.0	7.9	6.5	8.7	7.5
Total ammonia (ppm)	0.6	0.2	2.0	0.4	n/a	n/a

[1]The highest dissolved oxygen (mg/L) concentration that will be displayed by the YSI 85 is 19.0 mg/L.

TABLE 3.—Changes in water temperature (ΔT) experienced by fish during the Tracy Fish Collection Facility loading, hauling, and release procedures. Abbreviations are as follows: H.Tank = holding tank, H.Bucket = haul-out bucket, Pre-Haul = truck water sample prior to hauling fish, Post-Haul = truck water sample after hauling fish, and Release Site = water sample from fish release site.

	H. Tank to H. Bucket	**H. Tank to Pre-Haul**	**H. Tank to Post-Haul**	**H. Tank to Release Site**	**H. Bucket to Pre-Haul**
Mean	0.0	-0.6	-0.6	-2.1	-0.1
Median	-0.6	-0.3	-0.9	-2.4	0.1
Max (-)	-1.1	-2.1	-1.9	-4.6	-1.4
Max (+)	0.3	0.4	1.3	1.2	0.5
	H. Bucket to Post-Haul	**H. Bucket to Release Site**	**Pre-Haul to Post-Haul**	**Pre-Haul to Release Site**	**Post-Haul To Release Site**
Mean	-0.1	-1.7	0.0	-1.5	-1.5
Median	-0.2	-1.9	0.0	-1.7	-1.5
Max (-)	-0.9	-3.5	-0.8	-3.4	-2.8
Max (+)	1.0	1.5	0.9	1.2	0.6

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FIGURES ***21-point***

Changes in Water Quality During Fish-Hauling Operations at the Tracy Fish Collection Facility ***18-point***

Tracy Technical Bulletin 2008-2 ***16-point***

By ***12-point***

Zachary A. Sutphin[1] and Brandon J. Wu[2] ***12-point***

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FIGURE 1.—Map of the Sacramento-San Joaquin Delta depicting the Tracy Fish Collection Facility, Bill Jones Pumping Plant, and Emmaton Fish Release Site.

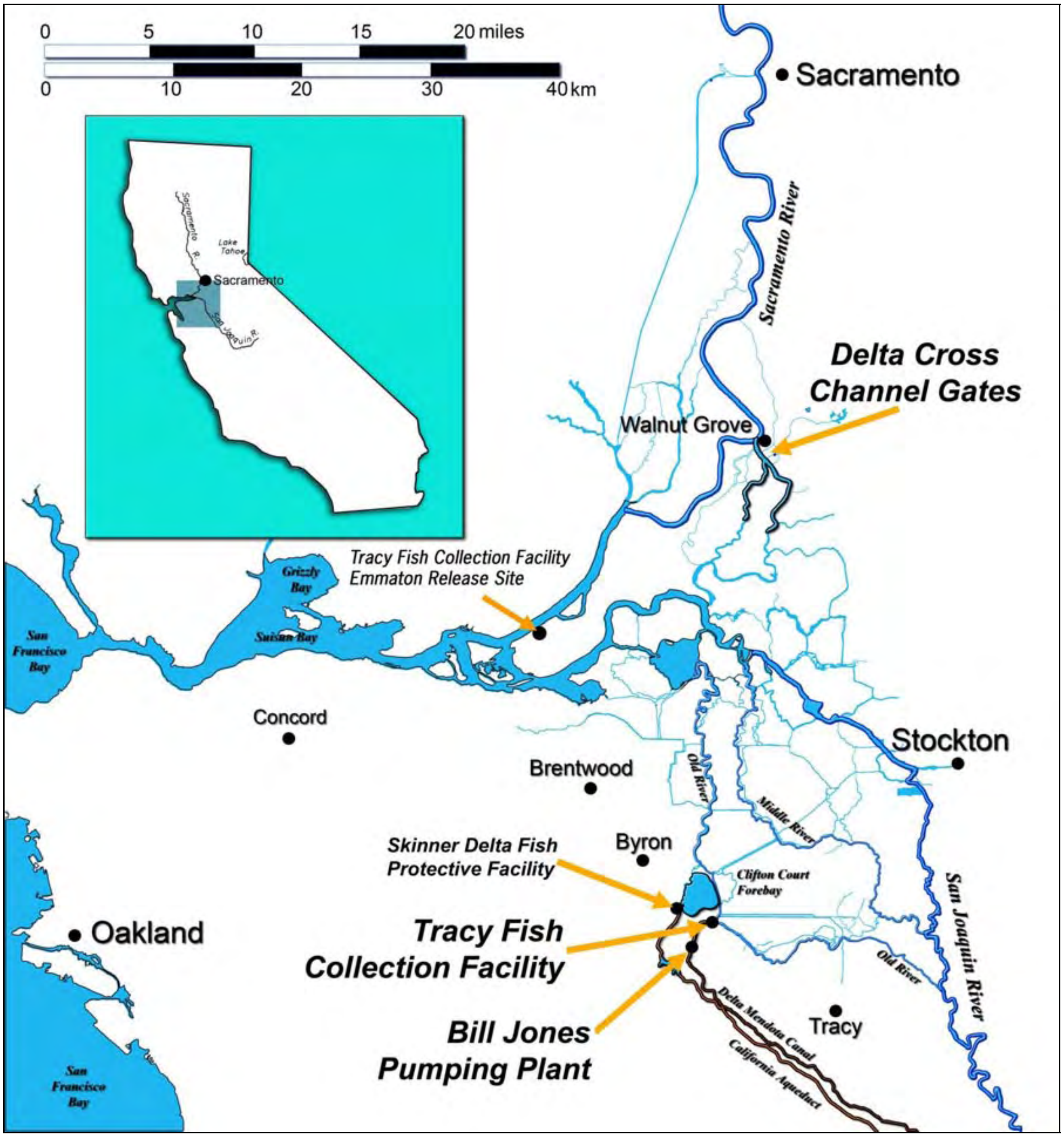


FIGURE 2.—Side view (left) and top view (right) of the Tracy Fish Collection Facility holding tanks used to support fish after collection and prior to hauling. Each of four tanks is (A) 6.1 meters in diameter and (B) 4.7 meters deep with conical shaped bottoms. A cylindrical wire mesh screen (C) 2.4 meters in diameter rests in the center of the holding tanks. Water enters each of four tanks through a (D) 51-centimeter influent line, passes through the cylindrical screen, (E) 46-centimeter drain opening, and exits through the (F) 51-centimeter holding tank drain.

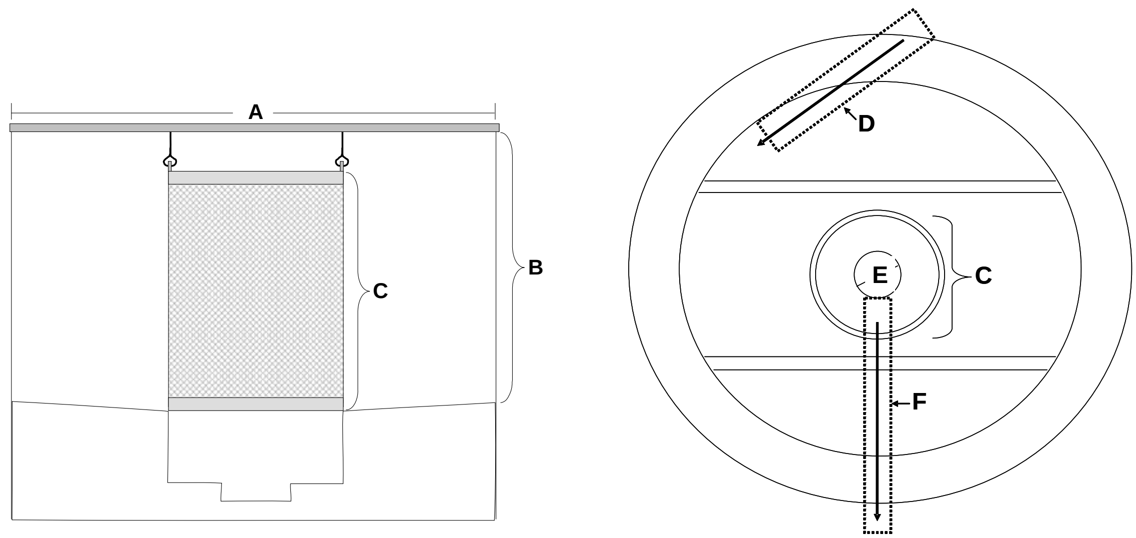
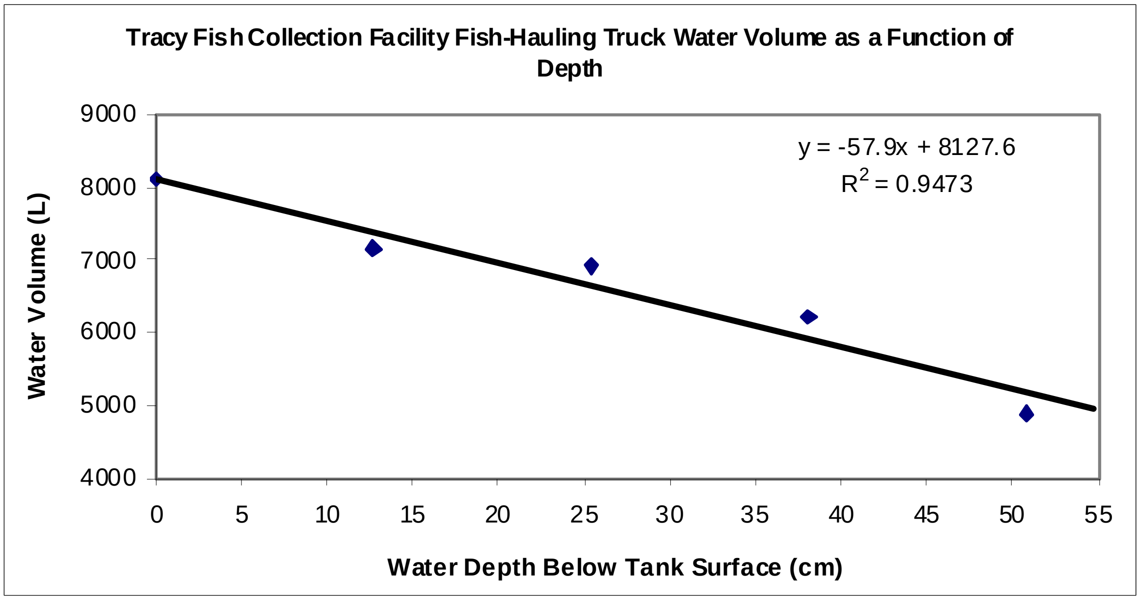


FIGURE 3.—The Tracy Fish Collection Facility fish-hauling truck. The tank is cylindrical in shape, 1.2 meters deep, 4.4 meters long.

FIGURE 4.—The Tracy Fish Collection Facility fish haul-out bucket.

FIGURE 5.—Tracy Fish Collection Facility fish-hauling truck tank water volume as a function of water depth below tank surface; measured as depth from top of tank to water surface.



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APPENDICES *21-point*

Changes in Water Quality During Fish-Hauling Operations at the Tracy Fish Collection Facility *18-point*

Tracy Technical Bulletin 2008-2 *16-point*

By *12-point*

Zachary A. Sutphin[1] and Brandon J. Wu[2] *12-point*

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Number tables and figures in appendix similarly: Table A1-2, Figure A3-6

Appendix 1 ***18-point – 6 lines down***

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Separate each appendix using a cover sheet similar to this.
Capitalize each word in title except for prepositions (at, the, of, a, an, etc.)

Appendix 5

Useful Unit Conversions

Weight

1.0 g = 1,000 mg = 1,000,000 µg
1.0 kg = 1,000 g = 2.204622 lb = 35.27396 oz
1.0 oz = 0.06250 lb = 28.34953 g = 0.0283495 kg
1.0 lb = 16 oz = 0.45359 kg = 453.59 g

Length

1.0 in = 0.0254 m = 2.54 cm = 25.4 mm
1.0 ft = 0.30480 m = 30.480 cm = 304.8 mm
1.0 yard (yd) = 0.91440 m = 91.440 cm = 914.4 mm
1.0 mi = 1,760 yd = 5,280 ft = 63,360 in = 1.6093 km = 1,609.3 m = 160,934 cm
1.0 cm = 0.010 m = 10 mm = 0.03281 ft = 0.3937 in
1.0 m = 100 cm = 1,000 mm = 1.0936 yd = 3.2808 ft = 39.370 in
1.0 km = 1,000 m = 100,000 cm = 0.62137 mi = 1,093.61 yd = 3,280.83 ft = 39,370 in

Temperature

Celsius to Fahrenheit:	°F = (°C x 1.80) + 32
Fahrenheit to Celsius:	°C = (°F - 32) x 0.5556
Kelvin to Celsius:	°C = °K - 273.15
Celsius to Kelvin:	°K = °C + 273.15

STP - standard temperature and pressure = 273 °K at 1 atm

Temperature Conversion Table

°C	°F	°C	°F	°C	°F	°C	°F
-40	-40.0	7	44.6	19	66.2	31	87.8
-20	-4.0	8	46.4	20	68.0	32	89.6
-15	5.0	9	48.2	21	69.8	33	91.4
-10	14.0	10	50.0	22	71.6	34	93.2
-5	23.0	11	51.8	23	73.4	35	95.0
0	32.0	12	53.6	24	75.2	36	96.8
1	33.8	13	55.4	25	77.0	37	98.6
2	35.6	14	57.2	26	78.8	38	100.4
3	37.4	15	59.0	27	80.6	39	102.2
4	39.2	16	60.8	28	82.4	40	104.0
5	41.0	17	62.6	29	84.2	45	113.0
6	42.8	18	64.4	30	86.0	50	122.0

Time

1.0 h = 60 min = 3,600 s

1.0 day = 1,440 min = 86,400 s

1.0 week = 168 h = 10,080 min = 604,800 s

Area

1.0 in^2 = 0.00064516 m^2 = 6.4516 cm^2 = 645.16 mm^2

1.0 ft^2 = 0.1111 yd^2 = 144 in^2 = 0.092903 m^2 = 929.03 cm^2 = 92,903 mm^2

1.0 yd^2 = 9 ft^2 = 1,296 in^2 = 0.836127 m^2 = 8,361.27 cm^2 = 836,127 mm^2

1.0 acre = 0.0015625 mi^2 = 4,840 yd^2 = 43,560 ft^2 = 4,046.87 m^2= 0.404687 ha

1.0 mi^2 = 640 acres = 27.878 x 10^6 ft^2 = 2,589,988 m^2 = 258.99 ha

1.0 cm^2 = 100 mm^2 = 0.1550 in^2

1.0 m^2 = 10,000 cm^2 = 1.1959 yd^2 = 10.7369 ft^2 = 1,550.0 in^2

1.0 hectare (ha) = 100 m x 100 m = 10,000 m^2 = 0.00385901 mi^2 = 2.47104 acres

1.0 km^2 = 100 ha = 1,000,000 m^2 = 0.3860 mi^2 = 247.104 acres

Volume

1.0 fl oz = 1.8047 in^3 = 0.029574 L = 29.574 mL

1.0 in^3 = 0.5541 oz = 0.016387 L = 16.387 mL

1.0 pint (pt) = 16.0 fl oz = 0.47318 L = 473.18 mL

1.0 quart (qt) = 2.0 pint = 32.0 fl oz = 0.94635 L = 946.35 mL

1.0 gal = 4.0 qt = 8.0 pt = 128 fl oz = 3.7854 L

1.0 ft^3 = 7.4805 gal = 0.028317 m^3 = 28.317 L

1.0 acre-ft = 1233.489 m^3 = 1.233 X 10^6 L = 325,851 gal

1.0 cm^3 = 1.0 mL deionized H_2O at STP = 0.001 L

1.0 L = 0.001 m^3 = 1,000 mL = 0.264172 gal = 1.0567 qt = 2.1134 pt

1.0 m^3 = 1,000 L = 8.1071 x 10^{-4} acre-ft = 35.315 ft^3 = 264.17 gal

Flow

1.0 gal/min = 0.0044191 acre-ft/d = 0.0022280 ft^3/s = 192.5 ft^3/d = 3.7854 L/min = 0.063090 L/s = 227.124 L/hr = 5,451 L/d

1.0 ft^3/s = 1.98347 acre-ft/d = 448.831 gal/min = 646,317 gal/d = 0.0283169 m^3/s = 28.3169 L/s = 2.4466 x 10^6 L/d = 2,446.6 m^3/d = 1,699.01 L/min = 101,941 L/hr

1.0 acre-ft/d = 0.504167 ft^3/s = 325,851 gal/d = 14.2764 L/s = 856.584 L/min = 51,395 L/hr = 1.23348 x 10^6 L/d = 1,233.482 m^3/d

1.0 m^3/s = 1,000 L/s = 35.315 ft^3/s = 264.17 gal/s

1.0 L/s = 1,000 mL/s = 0.0010 m^3/s = 0.035315 ft^3/s = 0.264172 gal/s

Atmospheric Pressure

1 atmosphere (atm) = 760 mm Hg (torr) = 29.9213 in Hg = 14.7 lb/in^2 = 101.325 kPa

1.0 pascal (Pa) = 1.0 N/m^2 = 1.45038 x 10^{-4} lb/in^2 = 0.00750064 mm Hg

1.0 bar = 100.0 kPa = 100,000 N/m

1.0 in of Hg = 25.4 mm of Hg = 3,386.38 Pa (at 0 °C) = 3,376.85 Pa (at 16 °C)

1.0 mm of Hg = 0.0393701 in of Hg = 0.0013158 atm =133.322 Pa = 0.019339 lb/in^2

1.0 lb/in^2 = 0.068046 atm = 51.71509 mm of Hg = 6.89476 kPa

Force and Energy

1.0 newton (N) = 1.0 kg-m/s^2 = 10^5 dynes

1.0 joule (J) = 1.0 N-m = 1.0 W-s = 0.239006 cal = 10^7 erg = 0.73756 ft-lb

1.0 eV (electronvolt) = 1.60219 x 10^{-19} J, 1.0 cal = 4.184 J

Chemical Concentrations

1.0 mg/L = 0.001 g/L = 1,000 µg/L = 1,000,000 ng/L

1.0 µg/L = 0.001 mg/L = 1,000 ng/L

1.0 ng/L = 0.001 µg/L = 0.000001 mg/L

1.0 percent = 1.0 g/100g = 10 ^{o}/oo (parts per thousand) = 10 g/kg = 10,000 mg/kg

1.0 g/kg = 0.10 percent = 1,000 mg/kg

1.0 mg/kg = 0.0010 g/kg = 0.00010 percent = 1,000 µg/kg

1.0 µg/kg = 0.001 mg/kg = 1,000 ng/kg

Appendix 6

Fishes of the Tracy Fish Collection Facility and South Delta

TABLE A6-1.—Common and scientific names of fishes salvaged and found near the Tracy Fish Collection Facility.

Common Name	Genus and species	Family
American eel	*Anguilla rostrata*	Anguillidae
American shad	*Alosa sapidissima*	Clupeidae
Bigscale logperch	*Percina macrolepida*	Percidae
Black bullhead	*Ameiurus melas*	Ictaluridae
Black crappie	*Pomoxis nigromaculatus*	Centrarchidae
Blue catfish	*Ictalurus furcatus*	Ictaluridae
Bluegill	*Lepomis macrochirus*	Centrarchidae
Brown bullhead	*Ameiurus nebulosus*	Ictaluridae
California roach	*Hesperoleucus symmetricus*	Cyprinidae
Chameleon goby[1]	*Tridentiger trigonocephalus*	Gobiidae
Channel catfish	*Ictalurus punctatus*	Ictaluridae
Chinook salmon	*Oncorhynchus tshawytscha*	Salmonidae
Common carp	*Cyprinus carpio*	Cyprinidae
Delta smelt	*Hypomesus transpacificus*	Osmeridae
Fathead minnow	*Pimephales promelas*	Cyprinidae
Golden shiner	*Notemigonus crysoleucas*	Cyprinidae
Goldfish	*Carassius auratus*	Cyprinidae
Green sturgeon	*Acipenser medirostris*	Acipenseridae
Green sunfish	*Lepomis cyanellus*	Centrarchidae
Hardhead[2]	*Mylopharodon conocephalus*	Cyprinidae
Hitch	*Lavinia exilicauda*	Cyprinidae
Inland silverside	*Menidia beryllina*	Atherinopsidae
Largemouth bass	*Micropterus salmoides*	Centrarchidae
Longfin smelt	*Spirinchus thaleichthys*	Osmeridae
Pacific lamprey	*Lampetra tridentata*	Petromyzontidae
Pacific staghorn sculpin	*Leptocottus armatus*	Cottidae
Prickly sculpin	*Cottus asper*	Cottidae
Pumpkinseed	*Lepomis gibbosus*	Centrarchidae
Rainwater killifish	*Lucania parva*	Fundulidae
Red shiner	*Cyprinella lutrensis*	Cyprinidae
Redear sunfish	*Lepomis microlophus*	Centrarchidae
Riffle sculpin	*Cottus gulosus*	Cottidae
Sacramento blackfish	*Orthodon microlepidotus*	Cyprinidae
Sacramento perch[3]	*Archoplites interruptus*	Centrarchidae
Sacramento pikeminnow	*Ptychocheilus grandis*	Cyprinidae
Sacramento sucker	*Catostomus occidentalis*	Catostomidae
Shimofuri goby	*Tridentiger bifasciatus*	Gobiidae
Shokihaze goby	*Tridentiger barbatus*	Gobiidae

Common Name	Genus and species	Family
Smallmouth bass	*Micropterus dolomieu*	Centrarchidae
Speckled dace	*Rhinichthys osculus*	Cyprinidae
Splittail	*Pogonichthys macrolepidotus*	Cyprinidae
Spotted bass	*Micropterus punctulatus*	Centrarchidae
Starry flounder	*Platichthys stellatus*	Pleuronectidae
Steelhead	*Oncorhynchus mykiss*	Salmonidae
Striped bass	*Morone saxatilis*	Moronidae
Striped mullet	*Mugil cephalus*	Mugilidae
Threadfin shad	*Dorosoma petenense*	Clupeidae
Threespine stickleback	*Gasterosteus aculeatus*	Gasterosteidae
Topsmelt	*Atherinops affinis*	Atherinopsidae
Tui chub[4]	*Gila bicolor*	Cyprinidae
Tule perch	*Hysterocarpus traskii*	Embiotocidae
Wakasagi	*Hypomesus nipponensis*	Osmeridae
Warmouth	*Lepomis gulosus*	Centrarchidae
Western mosquitofish	*Gambusia affinis*	Poeciliidae
White bass	*Morone chrysops*	Moronidae
White catfish	*Ameiurus catus*	Ictaluridae
White crappie	*Pomoxis annularis*	Centrarchidae
White sturgeon	*Acipenser transmontanus*	Acipenseridae
Yellow bullhead[5]	*Ameriurus natalis*	Ictaluridae
Yellowfin goby	*Acanthogobius flavimanus*	Gobiidae

[1]Chameleon gobies were last "observed" in the 1990s, but likely a misidentification of shimofuri goby.

[2]Hardheads were last "observed" in 2000, but likely a misidentification of Sacramento pikeminnow.

[3]Sacramento perch have not been observed since the 1980s, but are likely due to reintroductions by University of California, Davis and Contra Costa Mosquito Vector Control District.

[4]Tui chub are extirpated from the Sacramento-San Joaquin River Delta, but historical may have been salvaged.

[5]Yellow bullhead are currently found only in southern California and were most likely misidentified from brown or black bullhead.